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ABSTRACT

This environmental education program consists of two levels: primary and intermediate. The material in this publication encompasses the intermediate level. The learning materials are activity-based and incorporate process and subject area skills with knowledge and concern for the environment. The program is also interdisciplinary including activities and skills from art, language arts, mathematics, music, science, and social studies. The activities in this intermediate set center on exploration of the environment, identifying and solving environmental problems, and developing positive attitudes toward the environment. The materials consist of student activity cards, student information cards, and the teacher's guide. Each activity card lists the environmental problem, suggestions for investigating the problem, and an informal evaluation. The cards are non-graded and non-sequential. The teacher's guide contains overall teaching suggestions and suggestions by card. It also includes references for each card and four indexes on subject, subject area and process skills, information cards, and outdoor activities. (Author/MR)

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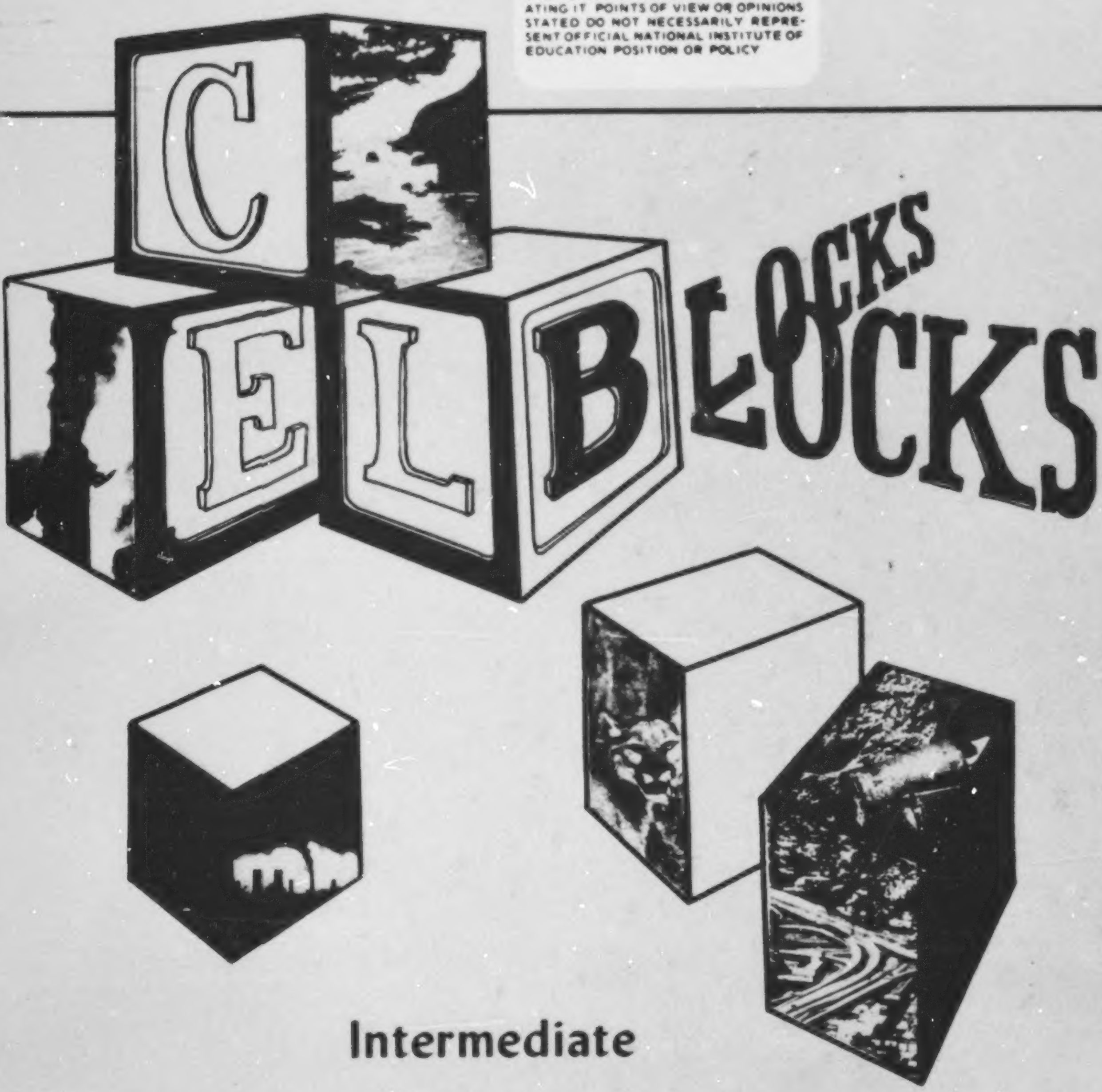

Intermediate

Interdisciplinary Environmental Learning Packets

2

SE 020 013

INTERMEDIATE CEL BLOCKS

Teacher's Guide

The School Board of Brevard County, Florida

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ELEMENTARY ENVIRONMENTAL LEARNING PACKET

Grades 4 - 6

SECOND REVISED EDITION

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Contributors
Marjorie Ebersbach, Elementary Specialist
Center for Environmental Learning

June Bryan	Freedom 7 Elementary
Don Cook	Cambridge Elementary
Karen Hiller	Divine Mercy Catholic School
Sue Parker, Illustrator	Rockledge High School
Phillip Rose	Edgewood Junior High
Gerald Sadlo	Lewis Carroll Elementary
Dan Voss	Cocoa Beach High School

Address inquiries to:
Marjorie Ebersbach, Coordinator
Center for Environmental Learning
615 Seminole Drive
Rockledge, Florida 32955

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Teacher's Guide — Intermediate CEL Blocks

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INTRODUCTION

How are these materials different?

These materials were developed and tested by classroom teachers working under the guidance of the project staff. The learning materials were found to be an effective tool for teaching environmental education.

CEL Blocks is interdisciplinary. The cards include activities and skills from the areas of art, language arts, math, music, science, and social studies.

CEL Blocks is an activity-based program, a "hands-on" approach to environmental education. These materials incorporate process and subject area skills with knowledge and concern for the environment. The program offers the student opportunities to explore and learn about the environment and to develop a set of values toward the environment.

CEL Blocks consists of two nongraded sets of activity cards, primary and intermediate. Each set offers opportunities for learning at varied levels and on varied topics. The primary cards focus on sensory awareness, basic ecological concepts, and developing positive attitudes toward the environment. The intermediate cards center on active exploration of the environment, identifying and solving environmental problems, and developing positive attitudes toward the environment.

How are the materials organized?

The materials in the intermediate set consist of the colored student activity cards, the white student information cards, and the teacher's guide. The student activity cards center around and are color coded according to three conceptual themes. The themes and the color coding are given below.

1. similarities and differences--blue and green
2. interaction and interdependence--pink and red
3. change and adaptation--yellow and gold

Each student activity card is a complete unit, with a built-in objective, activities, and evaluation. Each card presents a wide range of learning activities: investigations, experiments, discussions, simulations, readings, puzzles, or art activities. Each card and its activities is explained in the Teaching Suggestions section of the Teacher's Guide. The cards are non-graded and non-sequential. They can be used in any combination. The format of the intermediate student card is shown below. The student is given a problem dealing with the environment. Clues for you gives the student concrete suggestions for investigating the problem. Other ways to look at it gives optional suggestions for further insight into the problem. The teaching suggestions for each card gives suggestions as to how these activities may be utilized. The What did you discover? section contains an informal evaluation of the student objective.

Intermediate format

the problem:

Introduction . . poses a problem for the student

clues for you:

. . hints to solve the problem
. . may include
    investigation
    readings
    data
    materials needed
    suggestions for summarizing conclusions

Cautions noted

other ways to look at it:

. . additional suggestions for studying the same topic

. . student-structured inquiry

. . open-ended

what did you discover?

Evaluation
. . measures attainment of student objective

Student information cards are printed on white and are designed to be used in conjunction with the activity card they accompany. In some cases you may want to use the card as a master and duplicate it for the students.

The Teacher's Guide contains four sections: introduction, teaching suggestions, references, and indexes. The teaching suggestion section contains overall teaching suggestions and suggestions by card. The reference section lists supplemental materials which can be used to enrich each card. The index section contains four indexes: index by subject, subject area and process skills, index of information cards and index of outdoor activities.

How should these materials be used?

The developers of these materials were elementary teachers. They recognized the need for flexible materials that could be used in a variety of instructional situations. You should be able to fit these cards into the instructional strategies you normally employ. They can be used by large groups, small groups, or independent students. The cards can be used to supplement texts, as the basis for a unit on the environment, or as part of an independent learning center.

Since the cards are nongraded and non-sequential, you can choose the cards you think are most appropriate for your students. The cards have been indexed according to subject and subject area or process skills to help you select cards that complement the subjects and skills that are stressed in other materials.

The Teacher's Guide contains a section of teaching suggestions. In addition to general suggestions, this section contains ideas for implementing each card in your classroom. Again, many of these suggestions were contributed by classroom teachers who had taught the cards.

TEACHING SUGGESTIONS

FIELD TRIP SUGGESTIONS

The intermediate cards call for few field trips off the school grounds. There are, however, a large number of activities in the cards that call for outside exploration on the school grounds or nearby. In order for these activities to succeed, advance planning must be done by the teacher. Two checklists are included here: one is for on-campus activities, the other for field trips off the school grounds.

ON-CAMPUS CHECKLIST

1. Survey the area ahead of time. Be certain the students can make the needed observations in that area. If no suitable area can be found, try substituting another activity. Note any hazards you observe.

2. Secure any help necessary. If you plan to use other adults or older students, be certain they understand their responsibility as well as the group task.

3. Assemble necessary materials. The materials needed should be listed in the teacher's guide.

4. Prepare the class for their tasks. Discuss with the students ahead of time their responsibilities for observation, data collection, and conduct. If necessary, establish behavioral rules and standards of dress. With younger students, it is often necessary to simulate the activity in the classroom before going outdoors. Caution the students about hazards noted.

Hint: Start with short experiences and build from there. Be sure the students have enough to keep them busy. Some teachers find it helpful to give the students a clipboard with a data sheet as a reminder of their task.

The following list was developed to be used for field trips that require an absence from the school grounds. This checklist elaborates some of the suggestions given earlier.

CHECKLIST FOR FIELD TRIPS

I. Preparation

A. Secure a map of the area if applicable.

B. Make the trip yourself prior to taking the children. Complete a sketch of what routes you will use if necessary. Make sure you can accomplish what you set out to do.

C. Take advantage of guide service whenever the facility has it. Contact the guide well in advance if there are specific subjects you wish him to cover, so he will have ample time to prepare.

D. Make use of a resource person if you do not feel qualified in an area. Often he will meet with you if he is unable to accompany the class.

E. Make transportation arrangements through the office.

F. Secure a signed permission slip from every child for your protection.

G. Prepare a small first-aid kit. Include insect repellent.

H. Provide the children with a sketch of the proposed route. It promotes "ordered" confusion and later becomes an important addition to their data booklets on field activities.

I. Check restroom facilities or plan ahead.

J. Check food or drink facilities, if applicable.

II. Suggested Equipment

A. Collecting

1. Plastic bags
2. Small jars with lids
3. Large strainer, or collander

B. Observing

1. Hand Lenses
2. Binoculars
3. Picture-key books

C. Recording

  1. Pencils
  2. Field notebooks for records, sketches, maps, notes
  3. Camera, if so desired

III. Suggested Clothing (Plan for changing times)

A. Long pants (protection from insects, thorns, etc.)
B. Long sleeved shirt or blouse (above reasons)
C. Tennis shoes or old shoes (no sandals)
D. Canteens for water where needed

IV. Behavioral Rules

A. Walk by two's.
B. Stay with the group.
C. Form semi-circles around teachers or guides when something is being pointed out.
D. Be polite. Listen.
E. Respect property. Don't litter or destroy.
F. Walk quietly and listen well. You will see and hear more.
G. The teacher or guide will tell you what can be taken for collections.

V. Follow-up Activities

A. Reconstruct the area you visited.
B. Talk about the variety of living things that comprises your community.
C. Compare the school area to the visitation site.
D. Write or dramatize a story about some things you saw.
E. Encourage discussion about why we should preserve natural areas and be concerned about pollution.
F. Invite more resource people to visit.
G. Talk about hunting, fishing and game laws.
H. Discuss possible changes that could be expected as the seasons pass.

Student Objective: The student will be able to show, by means of a poster, at least five ways the environment affects his daily life.

Conceptual Theme: Interaction and Interdependence

Materials: information card, Daily Journal (1-1)
data card, Blank Form for Daily Journal (1-2)
newspapers, magazines, glue
scissors, construction paper

Teaching Suggestions: The object of this card is to illustrate the many ways our daily activities are influenced by the environment. The students are asked to document this interaction by keeping a journal of their daily activities. The students should be encouraged to keep as complete a journal as possible--not the same as a diary where only unusual experiences are recorded. The information card, Daily Journal is designed to give the student an idea of the type of things to record. The activities are also numbered and starred, as the students are asked to do later. Use the completed form as an example for the class to study and discuss. Once they understand the assignment, they should be given the blank forms or design a format for their own recording.

The clues for you section can best be done on an individual basis. Spend a few minutes each day looking over the entries to make sure the students are doing it correctly. Allow them this time each day to catch up on their journals. Remind the students the most efficient method is to record periodically throughout the day or at the day's end.

Once the students have finished recording events in their journal, they should go back and look at the events they recorded. Have the students star and number the events or activities that were affected by thie environment. On a separate sheet, the students should explain how that particular activity was influenced by the environment. Have the students study the information card for examples.

The other ways to look at it section includes optional activities which can be conducted in conjunction with art, language arts, social studies, and reading. Some of the activities are long-range, and should be undertaken as a six weeks or longer project. Many of these activities can be done by groups as well as individually.

The evaluation for this activity can easily be turned into a bulletin board display complete with pictures from this area. Try to find pictures that match the activities the students recorded in their journals. Pair the pictures with pages from the journals.

Student Objective: The student will be able to show, by means of a display, at least five ways man is still dependent upon his environment for survival.

Conceptual Theme: Interaction and Interdependence

Materials: information card, Ais Indians (2-1)
paper, pencil, chart paper
books on Indians of the U.S., early settlers of your area

Teaching Suggestions: This card is designed to help the students realize that they, like the earlier settlers of this area, are dependent upon their environment for survival. It is usually easy for the students to realize how dependent earlier settlers were upon the environment. It is harder for them to see their dependence upon the environment, since they rarely live close to the source of many of the raw materials. This is particularly true of students who live in cities.

The Ais Indians, subject of the information card, were early settlers of the east coast of Florida. If you live in another area, you may wish to substitute information about early settlers of your area. Even if the students do not live in this area, the information card should give them enough information to construct the chart called for in clues for you. This activity can be done by small groups or individual students.

Originate the activity by having the students read the information card or information you have located on early settlers of the area. The information card contains a vocabulary list of unfamiliar words. After the students have completed their reading, they should be able to construct a chart or list showing the ways the Ais Indians depended upon the environment for survival.

After the students have completed the chart on the Ais Indians, direct their attention to the ways their own needs are met. You may need to work through a few examples with the students to show them how to trace things back to the environment. (Example: cotton jeans--store--mill-gin-cotton plant; concrete block--sand, rock, cement, water.) You will probably need to give assistance in tracing some of the items back. If the students are stumped, look it up.

After the students have completed both charts, let them decide whether they are less dependent upon the environment than the Ais Indians were. Be sure they can justify their decision on the basis of their investigation.

Students can use their imagination or further research in writing about the disappearance of the Ais Indians. You may wish to have them read or record their stories for the rest of the class.

The students should locate their own raw materials to make tools, weapons, and shelter. Have them illustrate for the rest of the class the way they made the finished product.

Through comparing Indians from different areas, the students should see that the environment helped determine the type of clothing, food, shelter and tools that the Indians had. Some students might like to try making three-dimensional models of Indian homes or tools. They can also make drawings showing their clothing.

The early settlers of almost every area exploited the environment. The early settlers of Florida were no exception. The resource listed by Will is an excellent account of the area around Lake Okeechobee (see resources), although this is difficult reading for students. State or local histories of your area should provide further accounts.

Student Card #3

Student Objective: The student will be able to illustrate, by means of a collage, ways survival is dependent upon available resources.

Conceptual Theme: Interaction and Interdependence

Materials: information card, What Astronauts Eat (2-1)
paper and pencil
Coca Cola game, Space Adventure (see resources)
small scale or balance
magazines, scissors, glue, construction paper

Teaching Suggestions: Few places illustrate our total dependence upon the environment better than a space ship. This example helps students realize that there is a limit to available resources. The smaller the environment, the more quickly the limit is reached; the more people, the more quickly the limit is reached.

This is a good opportunity to combine writing and math skills with a knowledge of the environment. This can be done as an individual or small group activity. The initial figuring can be done by trial and error if the students cannot do division. (Or you can do it as an example.) Let them decide how they could make more use of the weight restrictions by making something that could recycle water and air. They might also think of ways to reduce the weight of the food by dehydrating it. Have the students write a story or keep a ship's log in which they cronicle their adventures.

The information card, What Astronauts Eat, illustrates how NASA has been able to solve some of these problems. The card also gives students a detailed look at the adventures of the astronauts in relation to meals. Do not let the students read this card until after they have come up with their own suggestions for extending flight.

Have the student hypothesize what would happen in case of a delayed return. The Coca Cola game (see resources) involves a hypothetical adventure where a ship is forced to take on more occupants. The two really pose the same question: what is the limit of resources?

Have the students pick a location where they could be marooned and reconstruct their adventures. Robinson Crusoe might make interesting class reading in connection with this activity. You might also take the class outside to a wooded area. Pupils could discuss how nearby materials could be used for shelter, and how they would go about finding food. An outside speaker could be contacted to talk on survival techniques.

To determine the amount of food they eat in one day, the students will need to weigh everything — liquids, snacks, and meals. A small postage scale or balance will do. To weigh liquids, weigh the container with the liquid and then the empty container. Subtract the weight of the container.

The earth has often been compared to a space ship. Like the space ship, we have limited resources. Unlike the space ship, there is no return to home port. If we ruin our environment, there is no escape.

Student Card #4

Student Objective: The student will be able to show by means of a visual presentation, things in his environment that please and displease him.

Conceptual Theme: Change and Adaptation

Materials:
notebook
pencil or pen
construction paper
camera (helpful)
aerial photographs (helpful)
pictures of the community (helpful)

Teaching Suggestions: This can be conducted as an individual or small group activity. The card can be initiated with a field trip around the school area for observational purposes. If you have available slides or pictures of the community, you can take the students on an a-v field trip. If you can cover areas in the community by walking, try a short field trip. Take along cameras if possible. Have the students look for things that displease and please them. Record them during the walk. After they return, they can answer the other questions in the clues for you section. Have them write or draw pictures of what they have seen. Discuss in each group the things they liked and disliked. How can unpleasant things be changed? How can pleasant things be kept the same? As a follow-up you can have them survey around their home with the same questions in mind.

Optional activities include dramatic, social studies, and science activities. Let each group choose those activities they would like to pursue. In order to gain a historical perspective, you might like to ask the Women's Junior Service League to present their suitcase exhibit on Brevard History. You might try talking to some of the older inhabitants of your community to see how it has changed.

Find out what types of zoning are in effect for the areas around your school, as well as the development for the future. The county planning commission, as well as your commissioner's office should be able to give you information on this topic.

Many of the students may not realize that most of what we know about past civilizations has come to us through a study of what they left behind--their garbage. Archeologists dig for remains that tell them about past life. Think about a typical garbage dump in your community. How would scientists judge your community? What things would they know about our society? Have the students list things they found in their garbage at home. What can the other students discover from their lists. You might want to make up "garbage cans" for the class and let them carry out this activity in class. Include clues as to whether or not children and pets are present, the family's eating habits, how thrifty they are, etc.

Student Card #4

For the evaluation, divide the class into small groups. Ask them to plan a visual presentation for the rest of the class. It should reflect their observations and feelings about the environment. Their presentation can take the form of a poster, collage, play, pantomine, puppet show, etc. Encourage the students to be creative.

Student Objective: The student will be able to list and explain at least three factors responsible for change in the design and construction of homes in his local area.

Conceptual Theme: Change and Adaptation

Materials:
- encyclopedia
- poster paper
- styrofoam or other scrap materials
- "home" magazines

Teaching Suggestions: If a field trip to different areas of your community is impossible, you may wish to take slides of some of the older homes in the area ahead of time. Be sure to highlight some of the more obvious changes: size and shape of the home, roof pitch, building materials, window type and size, presence of large porches, high ceilings, etc. Depending on the age of the community, you may be able to contrast several periods of construction.

Follow up this initial observation with a talk with a builder. If possible, invite a builder to talk to the class. Find out reasons for the observed changes. Houses have changed as the result of a number of factors: increased technology, new materials, increasing costs of materials and land, and changes in taste of the homeowner. Houses now have more luxury features. Rooms are smaller, ceilings lower.

It may be necessary to do some research to find out about the newer methods of building houses. Try to locate one dealer of prefabricated homes in your area. Request literature from him. Discuss the advantage of each type of house. These houses are more economical to construct, and in general are built to a tighter set of standards. Assembly of the house is much quicker than traditional construction.

The comparison of homes throughout different periods of history is a good group activity. Assign each group a different period of history to research. After they complete their research, let each group report to the class. This might be a good time for a little art history as well. Look for examples of different periods of history in the architecture.

As an optional activity, the students could visit a housing construction site with the builders permission. Arrange to talk to the builder while you are there. Consider also visiting a mobile home sales lot and a model condominium. Arrange to talk to sales people there. If this visit is not possible, an alternative would be to have a builder or salesman talk to the class. Be ready with a list of questions.

Student Objective: The student will be able to show, by means of a display, how the varied architectural styles and construction techniques used in building homes are a result of environmental influences.

Conceptual Theme: Change and Adaptation

Materials: "Home" Magazines, encyclopedia, construction paper, scissors, newsprint or poster paper, pencil

Teaching Suggestions: This card can be done in conjunction with the earlier one examining the effect of technology on the design of buildings.

This activity works well as a group project. You can assign each group a different area to research. Each group can plan a display of their findings. A data sheet might be helpful that includes all the questions in the clues for you section. This will mean each group will be looking for the same kind of things. Things the students may look for include number of stories, number and size of windows, building materials, roof pitch, size of house, presence of basement or attic, air conditioning and heating system.

When the students start to compare homes in their neighborhood, they should see the influence of the environment in the design of houses. By surveying a number of houses, the students should have a profile of a house typical of the area.

The question about other dwellings should include apartment buildings, condominiums, and mobile homes. Mobile homes probably show the least influence of the environment, since they may be designed for several areas.

Encyclopedias and social studies books should offer information on the houses of people in different areas of the world. The checklist developed in the clues for you section may be useful here as well. You may assign a different area to each group.

Frank Lloyd Wright designed many houses that blended with the environment including some of the buildings on the campus of Florida Southern in Lakeland. He also used materials found in the local area of the house. You should be able to find pictures of his famous houses in the encyclopedia or art history book. A guest speaker from the local Association of Architects might also provide an interesting program. Have the guest explain how architects must consider environmental factors in building a house.

Each area of the environment offers unique challenges to builders. Consider the special problems of your area. If you are still stumped, contact a builder.

Student Card #7

Student Objective: The student will be able to show, by means of a display, how materials from the environment are used in animal home building.

Conceptual Theme: Interaction and Interdependence

Materials:
a bird's nest
hand lens
reference books on birds
pegboard, string
poster paper

Teaching Suggestions: This card illustrates how animals utilize materials from the environment to build homes. Animals, unlike humans, are guided by instinct in their home-building. Guidance in obtaining a bird's nest may be needed in order to assure that the nest is not being used. It is not illegal to take an abandoned nest; it is illegal to take or distrub songbirds' eggs. The best way to avoid any conflict is to time this portion of the card to coincide with empty nests. The winter would be an ideal time, since nests can be spotted more easily then. You will need a nest for each group of students.

Have the students carefully analyze the nest, using a hand lens and tweezers. The students should note first the shape and general construction of the nest. Then have them list all materials found in the nest. When they have completed their observations, have them try to determine what type of bird built the nest. They will need reference books on birds for this.

When they have finished examining the nests, try this idea. Make the nests the central theme for the room. Start by locating dead limbs or branches from nearby trees. You can spray them or leave them the natural color. The limbs will be hung from the ceiling to form a mobile. Place one nest in each mobile. To add a finishing touch, you can have the students make origami birds to hang in the branches.

You can generalize this activity by having the students look for the homes of other animals. They will probably need to supplement their observation with research.

Nest-building is an example of a behavior that is in-born. The type of the nest is characteristic for each species, as is the location of the nest. The book by Gans (see references) is simple reading, but a good introduction to the topic. You can supplement this activity by having the students do water colors of one bird and its nest. Make a bulletin board display of the paintings.

The optional activity with the pegboard works best in the spring. The nest materials board can be stuffed with items found in the environment. It must be placed in an area accessible to birds and where they will not be molested coming or going. Replace the materials as they are taken. Keep a tally of the totals.

Student Objective: The student will be able to show, by means of a display, how careers and the environment are interrelated.

Conceptual Theme: Change and Adaptation

Materials: magazines
newspaper
career-related materials

Teaching Suggestions: The important point for students to consider in this activity is the influence the changing environment has had on jobs and how changing employment affects the environment. This idea is introduced by having the students look first at the career picture in their own family. The students should try to go as far back as possible in tracing careers. In stable communities this will be easier than in the more newly developed one. There should be considerably more diversity in jobs now than generations ago. The students need to make a chart including parents, grandparents, and as many other relatives as possible.

Have the students study the list of the jobs by generations. The questions in the second paragraph of the clues for you can be answered by a class discussion or individually.

In order to more fully explore the inter-relationship of jobs and the environment, have the class make a checklist of questions to ask people in different careers. They should include some of the questions in the clues for you, but may wish to add others. After the list has been developed, organize a panel discussion. You can invite resource people with different careers to the class or members of the class can research different careers and role-play for the panel discussion. Have the class ask the questions of the people representing careers. After the panel discussion, as a class make a list of ways careers affect the environment and the effects the environment has had on careers.

The "Careers Notebook" should be an on-going concern. It should be kept for at least six weeks. The students may want to develop a checklist of information for careers and interview people for information.

The students may have some difficulty visualizing how careers such as a mechanic fit into the environmentally related category. Think about controlling air pollution. Continue to add careers as you explore the activity cards on different problems. Keep a class list of all the jobs found by the students.

The idea that jobs are related to resources is an important one. The recent effects of energy-shortage illustrate this point. It also illustrates what happens when the resource is diminished. This makes a strong case for preservation of resources.

Student Objective: The student will be able to show, by means of a poster, at least three ways a specific agribusiness affects him.

Conceptual Theme: Interaction and Interdependence

Materials: encyclopedias, reference books
pencil, paper
large sheets of paper (for map)
crayons, markers
poster board

Teaching Suggestions: This card explores the interrelationships between agribusiness and the environment. An agribusiness is any business that depends upon the soil. Agribusinesses include fruit and truck crops and processing, dairy and cattle business, the forest industry and ornamental horticulture. Even students that live in the city are affected by these agribusinesses; they affect the economy and the environment. Each business, in turn, is dependent upon the environment. For this reason, most agribusinesses are regional in nature. Some, like ornamental horticulture, have been able to create an artificial environment to sustain them in unfriendly environments.

This can be done as an individual or group activity. If groups participate, you may wish to assign a different agribusiness of the area to each group. If the entire class participates, this would be a good opportunity for a field trip or a guest speaker. If you take a field trip, go prepared with a list of questions you wish to ask. If you cannot take a field trip or find a guest speaker, have each group research one agribusiness and answer the questions.

The optional activities help the students explore agribusinesses of other regions. Each group can research a different area and they can pool their information for the class map.

If your students conduct the survey on pesticides and fertilizers, help them draw up a questionnaire before they start. They should be familiar with the effects of each on the environment (see index for related cards). Have them analyze their data. Decide what use should be made of the results.

The evaluation can be done in groups or individually. Let the students present and explain their posters to the rest of the class.

Student Objective: The student will be able to list, in a paragraph, the factors necessary for the growth of a healthy plant.

Conceptual Theme: Change and Adaptation

Materials: data card, Plant Survey (10-3)
information card, Hydroponic Gardening (10-1)
(see information card for list of additional materials)
chart paper

Teaching Suggestions: This card can be done as an individual activity or in small groups. Originate the activity by asking the students to look around the school grounds for examples of healthy and unhealthy plants. The checklist in clues for you gives them hints as to what to look for that might make a difference in the growth of the plants. This checklist is reproduced on the data card, Plant Survey. Each group will need a copy. This activity is merely a survey. If the students wish to make quanitative measurements of these factors, they should be referred to later cards on measuring the microclimate of a habitat (see index). Qualitative measures are sufficient for the success of this card.

The students should do at least one experiment on one factor affecting plant growth. They may need help in designing an experiment for the other ways to look at it. They should read the information card, The Scientific Investigator (see index) before doing the experiment. Be sure they have a valid control and have manipulated only one variable in the experiment.

For the hydroponics investigation, the easiest way to get the nutrients is to use a balanced chemical fertilizer. There are many available in the stores that can serve the entire class. Some teachers prefer to have the students mix the solution so they will be aware of the different minerals in the solution. If your students use the liquid fertilizer, be sure to discuss what is in the solution. Someone from the Department of Agriculture or a local garden club might be willing to talk to the class about hydroponic gardening.

The idea of plants being limited by the environment is explored further on other cards. The idea here is to start the students thinking about the plants in this area by observation. The idea of special adaptations to this environment is also explored on later cards.

Student Card #11

Student Objective: The student will be able to list three functions of plant roots.

Conceptual Theme: Change and Adaptation

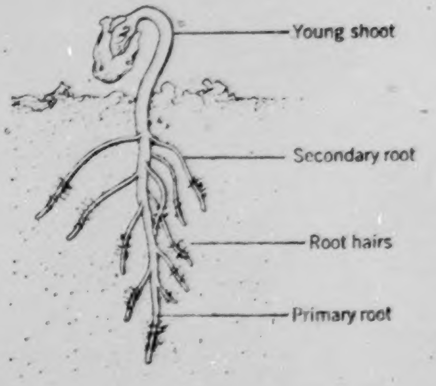
Materials: information cards — Using the Microscope (11-1) and Doing A Lot With A Little (11-3)

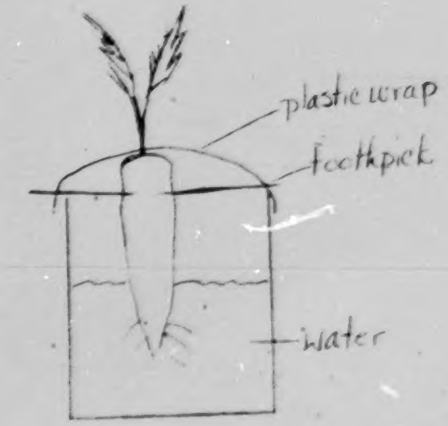
clear container
toothpicks
plant
cellophane wrap
pictures of foods
glue
scissors

radish seeds
microscope
glass slides
knife
rubber bands
poster paper or newsprint

Teaching Suggestions: Roots are an example of a specialized structure that allows the plant to meet certain needs. Roots absorb water and minerals, store food, help support the plant, and in some cases, aid in the propogation of new plants. Roots are also important to man. They provide a source of food for animals, prevent erosion, and their remains enrich the soil. This activity is designed to help the students realize the importance of roots to the survival of the plant, as well as their importance to the rest of the environment.

In examining different plants, the students should note the different kinds of roots. The diagram to the right illustrates primary and secondary roots and root hairs. Some plants, like carrots, have a highly developed primary root called a taproot.





This can be done as an individual or small group activity. The clues for you will proceed more smoothly if efforts to root a plant are carried out in advance of the main activity. Carrots and sweet potatoes are very easy. Secure the top portion with toothpicks to the lip of a clear container. The bottom of the plant should rest in a nutrient solution for quickest results. Plain water will also work. You will want to have a healthy plant before you begin. Carefully cover the top of the container with a cellophane wrap, allowing only the green part of the plant to protrude. Mark the level of the water and record daily changes. Any changes should be due to absorption since the wrap prevents evaporation. This illustrates one function of the root.

Have the students read the information card, Using the Microscope, before they work with one. The students should be able to make a slide and focus the microscope before they examine the root. After you are satisfied your students can work with microscopes, proceed with the second part of the activity. Although you can secure roots from many sources, the best ones for observation can be obtained by sprouting radish seeds on wet paper toweling. Radish seeds have numerous root hairs. They students should follow the directions given for preparing a slide, or you can use prepared ones.

Geotrophism (growth toward the center of the earth) can be illustrated with any roots. This experiment involves making a sandwich using a glass slide, radish seed, paper towel, and a second glass slide. After the ends have been secured with rubber bands, place one end of the glass sandwich in a pan of water. Be sure the seeds are not in the water. When the roots begin to grow, rotate the slides so the other end is in the shallow dish and observe what happens to the root. This experiment can also be used to illustrate hydrotrophism, growth toward water.

Additional activities illustrate two other functions of roots: storage of food and the prevention of erosion.

Student Card #12

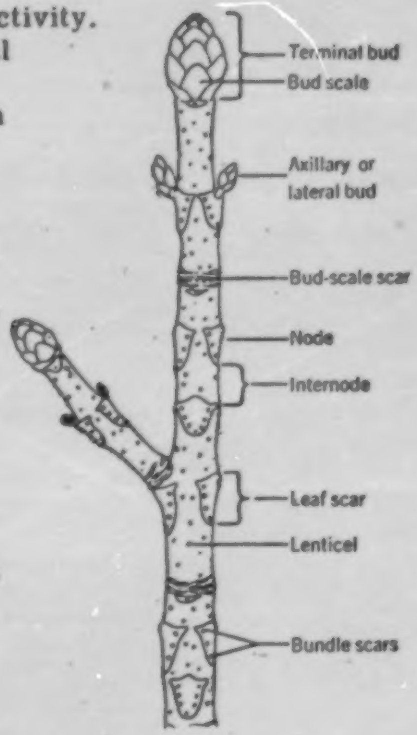
Student Objective: The student will show, by means of a display, one reason plant stems are important.

Conceptual Theme: Change and Adaptation

Materials:
- information card,
- plant stems
- books on plants
- tempra paint
- microscope
- newsprint
- Doing a Lot With a Little (11-3)
- hand lens
- knife
- food coloring
- slides of cross section of a stem
- magazines

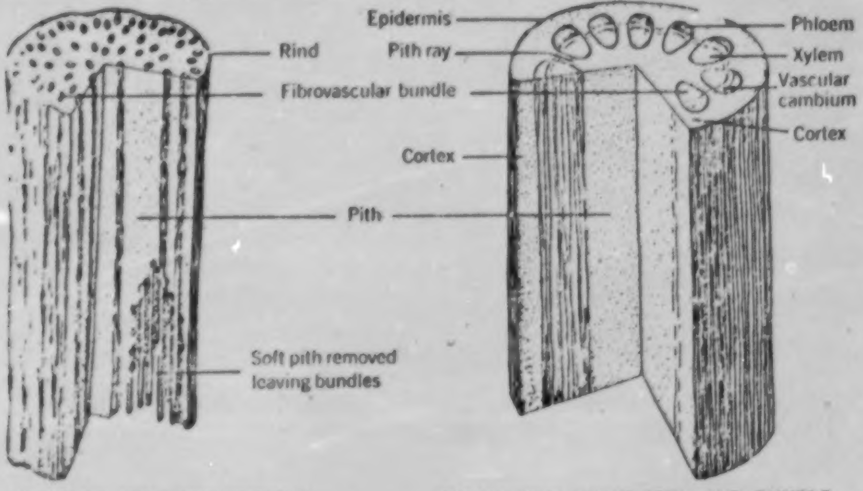
Teaching Suggestions: Plant stems are another example of a specialized structure of the plant that allow it to meet special needs. This activity is designed to help students investigate the structure and function of stems, as well as their economic importance.

This can be done as an individual or small group activity. The students should begin by observing the external structure of the stem. Each student or group of students will need a stem and hand lens. Ask them to look closely at the stem. The drawing at right indicates some of the external structures that can be observed on stems. The buds represent areas of new growth. In colder climates, the buds are protected by bud scales. When they fall off, they leave scars. The leaf scars mark the point of attachment of previous leaf stalks. On the leaf scars the students may note minute dots. These are called bundle scars, and show the location of the conducting bundles that carried water and dissolved minerals. The node is the point at which leaves or branches are produced from a stem. The space between two nodes is called an internode. Along the internodes the students may note tiny pores. These are called lenticels. They let air enter and water escape from the twig, especially while it is young and active.



The activity with the celery stem and food coloring can be set up quickly. The bottom of the stem should be cut just before it is placed in the solution. After twenty-four hours, examine the stem carefully to see how far the water was transported. The food coloring should have made the conducting tubes in the stem easier to see. Cut a cross section of the stem for the students to examine.

Stems, of course, contain the transport system for the plant. The phloem conducts food from the leaves to the other parts of the plant. The xylem conducts water minerals upward, as well as acting to support the plant. When the students examine the cross section of the stem under the microscope, they should be able to note vascular bundles containing the conducting tubes. The location of the vascular bundle will differ, according to whether the plant is a monocot or dicot. The drawing below shows the location in each type of stem.



MONOCOT STEM AND BUNDLE HERBACEOUS DICOT STEM AND BUNDLE

Prepared slides of cross sections of stems can be purchased from any biological supply house. You might also try borrowing them from high schools or junior highs near you. If you cannot obtain slides, direct the students to books that contain drawings of the cross sections of monocots and dicots. The students can make water color paintings of the cross sections. Mount them on construction paper.

Budding, grafting, and layering are three ways that stems may be used for plant propogation. Books can be obtained on the subject or you may wish to have someone from the department of agriculture, a nursery, or the local garden club demonstrate these techniques to the class.

Stems also have economic importance. Man makes use of the transportation system in plants to collect sap for syrup, turpentine and rubber. Man also uses the stems of trees for the production of lumber and paper.

Student Card #13

Student Objective: The student will be able to give at least one reason why leaves are important.

Conceptual Theme: Similarities and Differences

Materials:

leaves (see below for directions)
iodine solution
microscope
test tubes
large beaker
alcohol
starch
water
microscope slides
hot plate (optional)
information cards, Using the Microscope (11-1) and The Scientific Investigator (13-1)

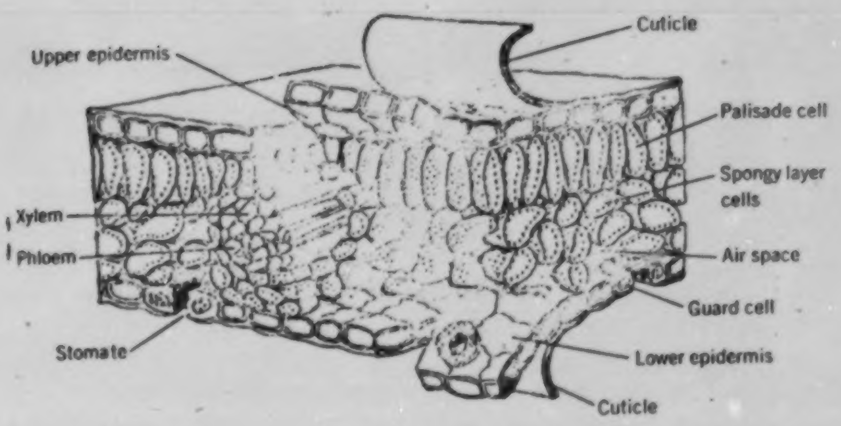
Teaching Suggestions: This card investigates the function of leaves as the food factory for plants. Students can be organized in small groups or they may carry out this investigation independently.

The initial investigation involves testing leaves for the presence of starch. Starch is a simple carbohydrate. The test for starch is iodine; it turns dark blue if starch is present. In order to test leaves for starch, you must first remove the chlorophyll. One way to dissolve the chlorophyll is to let the leaf soak for several hours in a solution of alcohol. A faster way is to boil the leaves in an alcohol solution in a beaker. Place the beaker in a water bath, on a hot plate. Remember that alcohol is highly flammable. The teacher should personally supervise the boiling of the leaves.

After the chlorophyll has been removed, place the leaf in a shallow dish. Place a few drops of the iodine solution on the leaf. The leaf that has been in the sun should turn dark blue; the leaf that has been in the dark should not turn. This, of course, indicates that sunlight is necessary for the leaf to manufacture food.

The green and white leaf illustrates that it is the chlorophyll that is responsible for the food-making activity in the leaf. A plant cannot survive without leaves, as the students can easily prove. The students should be able to design an experiment with a control before they start. If this is their first attempt, have the students read The Scientific Investigator first.

Cross sections of leaves are hard to get. Borrow some prepared slides from the local high school to show a cross section. The lower layer (epidermis) of the leaf will peel back quite easily. This shows the opening in the bottom of the leaf through which air passes. The students can identify the parts with the help of an encyclopedia. The film strip listed in the resources would also be helpful here.



This drawing represents the cross-section of a leaf with the cuticle and epidermis folded back to show the various tissues.

The drawing above shows the specialized structures within the leaf that allow it to perform its function. The epidermis, a thin layer of cells, covers the leaf at the top and bottom. It is protected by a waxy layer, the cuticle, which prevents loss of water. The lower epidermis contains tiny pores, called stomates. These pores regulate the passage of gasses and water vapor. Cells in the palisade layer and spongy layer contain chloroplasts. It is here that the manufacture of food takes place. The xylem and phloem conduct water and liquid through the leaf to and from the stem.

Leaf keys should help the students classify leaves. The keys are based upon similarities and differences in the leaves.

Leaf prints can be made in a number of ways. Two of the most satisfactory are ink and tempra prints. Begin by squeezing a half-inch of printer's ink on a glass square. Spread it into a thin, even layer by rolling the brayer over it in all directions. Place a leaf, vein side up, on a piece of newspaper. Ink the veins with a rubber roller. Place the leaf, inked side down, on a sheet of clean paper. Cover it with a piece of newspaper. Roll the rubber roller over the newspaper, pressing the leaf under it firmly against the printing paper. Remove the newspaper. Pick up the leaf carefully so that you do not smudge the print. The procedure is the same for tempra prints, just substitute a thick tempra mixture.

The filmstrip listed on leaves in the resources is an excellent compliment to this card.

Student Obejctive: The student will be able to identify by means of a chart the special adaptations of at least one plant.

Conceptual Theme: Change and Adaptation

Materials:
succulent plant, such as an aloe, cactus, or century plant
sharp knife
hand lens
ink (or dye)
construction paper

Teaching Suggestions: This can be done as an individual or small group activity. This activity may require close supervision because of the use of a knife. It should also be noted that some juices from succulent plants may cause irritation of the skin. Be sure to thoroughly wash all areas of the skin that come into contact with the juices.

The students may investigate one plant or several. They really should look at several from different environments to grasp the idea that a plant is fitted for a certain environment. This point is further pursued in the activity card on biomes (see index).

The tropical biome, of which south Florida is a part, has many unusual plants. Some of the ones that show unusual adaptations are the epiphytes or air plants. These are able to survive because of the high amount of moisture. Plants characteristic of each biome are discussed on information card 56-1 through 6.

Literature on the mangrove should be easy to locate. One excellent source is the Ecology volume of the Life Nature Library. If you live where mangroves are abundant, try to observe some. They grow only in salt or brackish water of tropical and subtropical seacoasts. They are important in the formation of sandbars and the maintenance of many kinds of animal life.

Check the reference section of the teacher's guide for specific references on plants of different areas. Plants are able to survive in many harsh environments.

If this is done as a group activity, you may wish to assign one area to each group to research.

Student Card #15

Student Objective: The student will be able to construct and analyze a soil profile.

Conceptual Theme: Similarities and Differences

Materials:

information cards, Constructing a Soil Profile (15-1) and Soil Profile Chart (15-2)
shovel
1" cards
plastic bags
glue
glass containers

Teaching Suggestions: With much of today's news concerning land use, students need a better understanding of man's needs and his dependence on the soil. Looking across the top of the soil does not show the real differences below the surface. One of the best ways of investigating soil differences is by constructing a soil profile.

This activity works best as a group activity. If several groups participate, you may wish to assign a different area to each group. Try to pick locations where you think the soil will be different: wooded areas, open fields, playground, etc. In some areas it will be difficult to find more than two layers. Spots that are grass free indicate poor soil and will probably yield only one layer. Land that has recently been dredged or filled is not suitable, but does offer a topic for discussion.

A good time to conduct this activity is right after a rain, when the soil is easy to dig through. A preliminary survey of areas near the school grounds may reveal areas that have been cut for roads or ditches. If they are still bare, you might take the class there to show them the soil layers.

Another activity would be to collect different kinds of soil if a soil profile was not available in your area. Discuss with your class why Florida has such sandy soil. Where did it come from? How did it get here? Students may need a hand lens or microscope to examine the structure of the soil. A microscope with the light directed at the top of the light shows a different effect.

If you feel you and your students need help with this activity, contact the Soil Conservation Service or the county agent in your area. Ask them to help construct the soil profile, test the soil, and discuss it with the students. Ask them to recommend plants that will grow on your school grounds. Try growing some of the plants there. Many of these plants are available from the Department of Forestry at very reasonable prices.

You can make 3-dimensional soil profiles from the samples your students collected. Have them pour the soil samples into the container to approximate the levels they found.

Student Card #16

Student Objective: The student will be able to list and classify the organic materials found in the topmost layer of soil.

Conceptual Theme: Similarities and Differences

Materials: chart, Organic Materials Survey (16-1) one for each group

baggies or small bags
4 stakes
brown tempra paint
masking tape
sponge or brush and screen
string
newsprint
construction paper
scissors

Teaching Suggestions: This activity involves the investigation of the organic materials found in the top layers of the soil. This card can be done in conjunction with the others on soil; in fact, you may want to do this one before the one on soil profiles.

Organize the class into groups. Assign each group an area to investigate. They need to take their materials with them to the area. Before they start, they should make predictions as to what they think they will find. Once they start, the students should be cautioned to carefully sift the materials. Small pieces can be missed easily. In many undisturbed areas, nature carries out its own composting activity. The students should notice the progressive stages of decay as they move downward in the top layers. They will probably also find evidence of decomposers at work. Other cards in the set discuss decomposers (see index).

When you return to the room, allow the students time to organize their data. Then have them report to the rest of the class on what they found. An excellent way to communicate their discoveries is through a three-dimensional sponge or spatter painting. They should begin by providing a background of brown on newsprint. They can use a sponge dipped in the tempra, or a toothbrush and screen. While the background is drying, have them prepare the cut-outs to add. They can cut-out figures of animals and plant parts they found in the soil as well as the words themselves. Brown and black are usually the best colors for this. Have them add the cut-outs with a loop of masking tape. They can post their display for the rest of the class. This display simulates their own investigation. From a distance, one cannot tell what organic materials are in the soil. Upon closer inspection, however, one can detect what the materials are.

Student Card #17

Student Objective: The student will be able to measure one of the following non-visible differences in the soil: pH, temperature, or soil bacteria.

Conceptual Theme: Similarities and Differences

Materials:
- pH paper
- distilled water
- test tubes
- plastic bags
- nutrient agar
- petri dishes
- thermometer
- chart, Non Visible Soil Differences (17-1)

Teaching Suggestions: This card investigates three of the non-visible differences that help determine the type of plants that will grow in soil. This card can be done in conjunction with the others on soil as well as the cards on the mini-climate of a habitat.

For the purposes of these investigations, the students may work independently or in small groups. The first investigation involves taking the temperature of each of the layers of soil in the soil profile. Be sure the students know how to read the thermometer accurately. Students should be supervised with the use of the thermometers to prevent breakage. Rather than having the students insert the thermometers into the soil, they should make a cut into the soil with a trowel. As the towel is withdrawn, the thermometer should be inserted into the cut. The depth of the reading should be recorded as well as the temperature. The chart 17-1 shows the relationship of soil temperature to growth.

The second factor the students are asked to measure is the pH. The pH is a measure of the acidity (or basicity) of the soil. It is not necessary to go into a detailed discussion of pH with the students; it would probably confuse them. Briefly, materials have a characteristic pH. The scale of pH runs from 1 to 14 (see below). Materials that fall below 7 on the scale are classified as acids. The smaller the number, the stronger the acid. Materials with pH's above 7 are bases. The higher the number, the stronger the base.

1 ———————— 7 ———————— 14

acids bases

The students can get a point of reference by measuring familiar substances. Vinegar, lemon juice, and soda pop all are acids. Using pH paper and the scale, the exact pH can be read. Ammonia and chlorine bleach are bases. Have the students read the pH of the soil samples as described on the card. Again, 17-1 indicates how pH is related to plant growth.

The final measurement involves growing cultures of soil bacteria. Prepare petri dishes with nutrient agar (see references for books with directions). Care should be taken not to contaminate the agar plates before or after the soil samples are introduced. If disposable petri dishes are used, dispose of them in a plastic bag or incinerate them. The information card, Partners (see index) gives further information on how soil bacteria work.

This is a good time to invite someone from the soil conservation service or your county agent. Have them discuss with the class why these non-visible differences are important in the growth of plants. You might ask them to test the soil on your playground and recommend plants that will grow there.

Student Obejctive: The student will be able to cite at least one example of an adaptation to a seasonal change.

Conceptual Theme: Change and Adaptation

Materials:

encyclopedia	frog
books about animals	ice
pencil	jar
paper	large, shallow container
thermometer	

Teaching Suggestions: This works well as a small group activity.

Students can watch an animal adapt to cold weather by putting a frog to sleep. Any common frog or toad will do. Place him in a glass container. Count his "pulse" by watching his throat. Record the temperature of the container and his breathing rate. Place the container in a large, shallow tub of ice. Continue to record the frog's "pulse" rate and temperature of the container at two-minute intervals.

Other changes that might be investigated: animals changing coat color, crayfish shedding skins; dogs, horses, grow long hair in winter.

There is an activity card on writing Cinquain poetry and an information card on Haiku poetry for the students interested in poetry.

In this area, students may need to think of adaptations to heat and drought as well as cold.

Student Objective: The student will be able, by means of a chart, to list and compare the structural adaptations of at least four aquatic animals.

Conceptual Theme: Change and Adaptation

Materials: pictures or specimens of local aquatic life (Florida Wildlife Magazine)
colored pencils
construction paper

Teaching Suggestions: This works well as a group activity. If several groups participate, you might assign one animal to each group. Try to secure live speciments of these animals where possible. If these animals are not abundant in your local environment, substitute four that are. The BFA Study Prints listed in the references are excellent for use with this card. Each child could sketch his animal in its natural environment. Discuss the interaction between the animal and the environmental factors included in the picture. Be sure to point out ways the animal is adapted to its environment.

Animals can come from the ocean, or they could represent those living in an aquarium if four different kinds are available. Fresh water clams will live in an aquarium. A salt water aquarium also would be helpful and this can be stocked from the local area.

To compare the skeletons of a different group of animals, the animals can be boiled until the flesh breaks away from the bones, or the animals can be placed outside and the ants will do a good job of cleaning them. Be sure roaming dogs or cats don't get into the area. The comparisons do not have to involve the skeleton comparisons.

A rabbit, squirrel, bird, and grasshopper could be easily found for the land animals. This activity would be good for a field trip to a vacant lot.

Student Card #20

Student Objective: The student will be able to recognize at least 3 specific adaptations of structure or behavior that suit an animal to a particular environment.

Conceptual Theme: Change and Adaptation

Materials:
information cards, Habitats (20-1) and The Survivors (57-1)
pencil and paper
camera (helpful)
binoculars (helpful)
cardboard
twigs, glue, water colors

Teaching Suggestions: This activity can best be accomplished individually since this type observation is difficult with groups. Unless the students have already studied habitats, they should begin by reading the information card, Habitats.

You will need to schedule outside time for observation. You might allow the students an initial observation period before selecting the animal they are to study. Be sure they do not select their pets. Habitats they might want to consider would include a ditch, rock, fallen log, grassy area, a tree, area under shrubs, etc. For a greater variety in observation results, students may pursue this activity after school or even a weekend. If a child is especially interested in a particular animal, some hypothesizing and/or research could be done. For a variation you can repeat this same activity with plants. A class list could be compiled and small groups could investigate different plants. This activity lends itself well to field trips.

Optional activities include a discussion of the idea of adaptation to a changing environment. Through an awareness of current local events, the students should be able to identify changes which will affect the animals. Animals which cannot adapt to these changes face extinction. This point is pursued in the card, The Survivors.

The mini habitats are simple to make. Start with a plant or a model; for example, a piece of rotting log. Attach to that plant or model, by means of a twig, animal typically found in that area. On the back of the animal attach a list of the animal's adaptations to that habitat.

Student Objective: The student will measure and compare the fright distance of animals of at least two different species.

Conceptual Theme: Similarities and Differences

Materials:

- white cloth
- 100 foot tape
- paper
- information card, The Scientific Investigator (13-1)
- clipboard
- pencil
- binoculars (helpful)

Teaching Suggestions: This card explores the idea of timidity in animals. Timidity is really an inborn defense mechanism in animals. The fright distance of animals, however, can be changed through training or repeated exposure to man.

This activity should be done with students working in pairs or individually. Animals to use are squirrels, rabbits, or birds. The students will need patience to complete this task, since several measurements are required. This activity may take a long time to complete.

Variations of this experiment are given in other ways to look at it. The students should read the information card, The Scientific Investigator, before they try to design an experiment of their own. The fright distance of some animals can be changed through repeated exposure to man. The offering of a reward usually aids in this change.

Observations of animals in public areas should lend strength to the idea that the fright distance of animals can be lowered through repeated exposure to man.

Instructions for writing cinquains are given on another card (see index). The students may want to do charcoal sketches of the animals they observed as well. Use these for the bulletin board along with the data they collected.

Student Objective: Using a method of his own selection, the student will be able to show at least three ways one bird is adapted for life in its habitat.

Conceptual Theme: Change and Adaptation

Materials:		
	reference books	bird bones and feathers
	bones of other animals	balance
	information cards, Brown Pelican (49-4) and Microbalance (22-1)	
	hacksaw	

Teaching Suggestions: The point of this activity is to illustrate the specialized structures that adapt birds for life in a given habitat. If the birds listed under clues for you are not found in your area, substitute four that are.

This card can be done individually or in small groups. This investigation offers an excellent opportunity for the student to observe first, then research. Schedule time for the students to observe the birds in their natural environment. For students in Brevard County, the Merritt Island Wildlife Refuge would be an excellent field trip.

If this is done as a group activity, you can assign one bird to each group, or four different birds to each group. The groups should compile information for a chart or bulletin board that illustrates the ways that each bird is adapted to its habitat.

In order to compare the weight of bird bones the student will need bones and a sensitive balance. If the school does not have a balance, directions are given on the information card, Microbalance, for making one. This balance will need to be calibrated before it is used with the bird bones. Start by marking zero on the balance. Then place a new nickel in the pan. It has a mass of 5 grams. Measure the distance the pointer has moved. Divide it by 5. This new length is equal to one gram. You can divide this into tenths if you wish.

The students may find it enlightening to compare the bones of birds with those of non-flying animals. The more advanced students may try to compare the density of the bones. Density is the weight per unit volume. Students can measure the volume by displacing water. Then to find density use this formula:

$$\text{Density (g/ml)} = \frac{\text{mass (g)}}{\text{volume (ml)}}$$

In Florida, the Brown pelican, the Everglades kite, the Bald eagle, and the Ivory-billed woodpecker are all on the endangered list. More information about each of these birds is given on information cards (see index). The main reason for the decline in these animals appears to be habitat destruction. Some are also endangered due to pesticide poisoning.

Student Card #23

Student Objective: Based upon research, the student will be able to properly classify five local plants or animals as to survival techniques.

Conceptual Theme: Change and Adaptation

Materials:
information card, Six Ways to Success (23-1)
chart or construction paper
reference books on plants and animals

Teaching Suggestions: This is one of the more complex cards and should be undertaken only by advanced students. Because this activity calls for research, guidance may be needed as to sources of information and readability of reference books. Simple guide books may yield the most readable information.

You may want to have someone from the local Department of Agriculture or local pest control companies talk to the class about local pests. Have them explain what survival techniques these animals have that make them so hard to get rid of. In Florida, mosquitoes are a good pest to research.

Most animals on the endangered list are there because their environment is changing, not because their survival techniques are faulty. Since survival techniques are inborn they can't be changed in response to changes in the environment.

This might be an appropriate time for a visit to a nursery or have someone come to the class. Arrange beforehand to have someone show the students how plants are started from seeds, shoots, and slips. Talk about the ways trees and plants reproduce naturally as well as the ways they are reproduced artifically.

Student Card #24

Student Objective: The student will be able to measure the population of at least one living thing over a period of several weeks.

Conceptual Theme: Interaction and Interdependence

Materials:
- dead grass
- hand lens
- microscope
- slides
- ditch or pond water
- coat hanger
- notebook
- quart or gallon jars (glass)
- boiled egg

Teaching Suggestions: A population can be several different things. It can be the number of people in a city or country, or it can be the number of ducks on a pond, the number of trees in a forest, or the number of mice in a vacant lot. Students need to realize the application of this term to several different kinds of living things.

This activity is a group activity. The sample of pond water must include some of the materials from the bottom of the pond or ditch. A place in the school yard where water stands during rainy weather is the best place to get the dead grass. Be sure the grass has dried before the students collect it. The experiment takes at least three weeks to complete and works better if it is continued for four or five weeks. Observations can be taken every other day after the second week. One hard boiled egg will serve for the entire class for the four weeks. The jars should be covered because of the odor that develops after several days. The odor goes away in a week. If there is no activity in the jar after two weeks start over. Several groups should do the experiment. The paramecium will probably be the first animal identified. These will increase in number very rapidly, then will die out to be replaced probably by rotifers.

The students should identify one animal and do a population count on that animal each day. The population of the animal should increase, level off, and then decrease. The graph of this data should yield the typical population curve. The factors which act to limit populations is discussed in the information card, The Environment Cork.

The activity with the coat hanger can be carried out in any nearby area that is vacant. Before beginning, have the students bend the hook portion of the hanger into a circle. This will prevent injuries. Be sure the students do not forget the populations of plants in the hanger as well as the animals. The different populations are constantly interacting. In larger areas, populations interact to form an ecosystem. See the index for cards on ecosystems.

If the students are uncertain what effect the killing of a predator has on other populations, refer them to the cards on food webs and ecosystems.

Student Card #25

Student Objective: The student will be able to identify and discuss population trends from data supplied.

Conceptual Theme: Change and Adaptation

Materials:
- graph paper or ditto of 25-1
- pencils
- ruler
- poster board
- magazines
- scissors, glue

Teaching Suggestions: The object of this activity is to have students study local population data, identify trends, and discuss reasons for population growth or decline. If you live in an area other than Brevard County, you will need to supplement the information on this card with local population data. This can be obtained from your local chamber of commerce.

This can be done as an individual or group activity. If several groups participate, you may wish to have state and national data for them to compare. This activity presumes student ability to construct a graph. If your students lack this ability, you can make the graph for them, or you can use this lesson in a unit on graphing.

If you live in another area, you can use the data on Brevard County as an example for the class. The students can locate Brevard County, Florida on a map and probably infer reasons for its rapid growth when they realize that Kennedy Space Center located there in 1960.

Graph your local population data and answer the questions included in clues for you. Other ways to look at it includes the surveying of residents in the area, as well as the use of resource people. You might want to also invite someone from the local planning commission to talk to the class about the area's potential for growth.

When your students talk to long-time residents of the area, you may wish to tape record the interview, or invite the people to class. Ask them if they have any pictures they can share with the class. If you have trouble contacting long-time residents, consult your local historical society. The Junior Women's Service League has a suitcase exhibit that traces the development of Brevard History.

Discuss what things the students would like to find out about the population in your area. Think of everything they can ask residents. Have them design a questionnaire before they begin the survey. Be sure to have the survey form approved before the students conduct their survey. Help them organize and analyze their data.

The students should try to list all the resources of an area that are affected by changes in population. Then they can make their collage. There is a real question as to how many people South Florida can support. Water resources, availability of land, electricity, and sewage treatment are all limiting factors.

Student Objective: The student will be able to show, by means of a collage, what the world will be like in thirty-five years.

Conceptual Theme: Interaction and Interdependence

Materials: encyclopedia
counting blocks
information cards, World Population (26-1), Death Rates (26-4)
The Environment Cork) (24-1)
World Almanac
materials for collages

Teaching Suggestions: This activity can be used as a small group activity or as an individual activity. Any type of block can be used. If none are available, the students can use rocks or squares of paper. The time of the activity is limited only by the number of blocks available. The students should soon become aware of the way the population increases.

The card, World Population lists several reasons for the population increase. Medical advances have slowed death rates, people live longer, technological increases allow the world to support more people. Basically, the population increase boils down to one fact: people are being born faster than they die.

The information card, The Environmental Cork, discusses natural populations and their controls. Man has been able to overcome these natural controls and the students need to discuss how this has been done.

The field trip to a cemetery should include an old cemetery. The students should then convert the data to percentages to show the death rates for each of the years. The more data this experiment has the more accurate the percentages. Be sure the tombstones are picked at random are not by name or looks. The data could also be plotted on a graph. This will require considerable teacher help. If some of the students have calculators at home this could be an aid for computing the percentages.

The World Almanac has material on the numbers of people in each country as well as populations of the United States for various years.

The collages for the evaluation can take any form the students desire. Have them discuss their content with the rest of the class.

Student Objective: The student will be able to show, by means of a display, at least three problems associated with an ever-increasing world population.

Conceptual Theme: Interaction and Interdependence

Materials:
information card, Problems With Population (27-1)
25 pieces of food
resource books

Teaching Suggestions: This activity is designed to focus on the problems of an ever-increasing world population. It should be done by the entire class, since the simulation requires 25 students. The simulation under clues for you is designed to illustrate the density of the world population. Other ways to look at it continues this demonstration by showing the distribution of food by continents. You may wish to have each group of students research other resources of each continent so they will be aware of materials that can be traded for food. If you wish, each country can be given resource cards which they can trade for food.

The remainder of the activities center on the problems that people bring. In addition to the demand for food, there is the need for shelter, water, and the disposal of waste. The card, Problems with Population, points out that Americans account for the consumption of a large amount of resources and the production of a great deal of pollution. Of course, a great deal of this is due to the industralized character of the nation.

The students may wish to do the evaluation in groups. Have each group plan a display that will show at least three of the problems a growing population creates.

Student Card #28

Student Objective: The student will be able to show, by means of a model community, his own priorities for land usage.

Conceptual Theme: Interaction and Interdependence

Materials:
- encyclopedia
- World Almanac
- Cocoa-Cola game, Make Your Own World

Teaching Suggestions: This card is designed to start the students thinking about land usage. It can be done as an individual or small group activity. Begin by having the students calculate the amounts of land needed to feed various groups. Consider the possibility of eliminating meat from the diet. This has been suggested by some nutritionist and conservationists. This would greatly increase the number of people that could be fed from the world's croplands.

The chart given under other ways to look at it should help the students realize that there is not that much idle land in the United States. They should debate the question of where additional land for cities and transportation should come from. As we add more people, we will need more land for these purposes. Of course, more people also means more land for producing food will be needed.

The Coca-Cola game mentioned is an excellent compliment for this activity. It involves the planning of a town. If you do not already have this game in your school system, contact your local bottler to find out how you can get the game.

The evaluation can be done individually or in groups. Be sure to remind the students of the need for adequate sewage treatment, transportation, and recreational facilities. Land will also be needed to produce food for the people in the community.

Student Card #29

Student Objective: The student will discuss the problem of litter on the school grounds and try at least one way to reduce the amount of litter.

Conceptual Theme: Interaction and Interdependence

Materials:
- notebook
- paper
- tape measure
- information card, Making A Map (29-1)
- pencil
- watch
- trash cans or bags

Teaching Suggestions: The students will need to work around the school grounds. It may be an individual small group, or class activity. If this is done as a group activity, you might use a large map of the school grounds and assign an area to each group. Students may need assistance in mapping. One large map may be enough for the entire class. This would be a good time for a lesson on mapping. The information card listed will be helpful as well as the book listed in the resources.

Have the students collect the litter they find. Discuss what they find. Talk about the sources of the litter. Discuss how each type of litter will affect the environment. A trip to a dirt road "unofficial" dump may be illuminating to the class.

The following chart can be used as a model for discussion.

Location	Types of Litter	Amount	Source of Litter	Re-cyclable?	
				Yes	No

As well as measuring the volume of litter, you may want to try weighing the litter collected.

The students should decide on at least one project to reduce the amount of litter. If the entire class participates, each group may want to try a different method.

This card is a natural teamed with the following one on recycling.

Student Objective: The student will become aware of the role he is playing in our "throw-away" society.

Conceptual Theme: Interaction and Interdependence

Materials:
paper and pencil
information cards, Recycling (30-3) and The Things We Throw Away (30-1)
garbage
shovel

Teaching Suggestions: The initial activity of these cards is designed to focus the student's attention on his part in the problem of solid waste. Have students position a record card near the garbage can in their houses. Have students ask other members of their family to record everything they throw away. Once the list is complete, discuss the items. How many of these things will not decay? Could any of these things have been recycled? Could any have been reused? Repaired? You might wish to have a contest to see how many new uses you can find for egg cartons, milk containers, etc. Discuss also things that can be given to service agencies in your area. The card, The Things We Throw Away, focuses on the national problem of solid waste disposal in your area and the nation. Research is under way on new methods. Some of these methods are illustrated in the film, The Third Pollution (see resources). This film is suitable for upper elementary students.

Composting is really simple. You can put almost anything organic in your compost except meat. The meat will smell and attract flies. Pick an out-of-the-way corner for your composting. It should receive some sun. Dig a pit two feet deep and two or three feet square. Spread the material for composting in layers. Use a variety of materials and wet each layer. Cover the pile with boards or burlap weighted down with stones. Add a layer of hay or weeds. You can tell if the compost is working by checking the temperature with your hand. If there is no heat, you need to add more manure, grass clippings, leaves or water. Check the pile in a couple of weeks. (The actual time varies depending on the temperature.) The compost can be used in gardening. The time needed for the composting can be reduced by shreeding the material and turning the compost.

The students may do their price comparing on a shopping trip with their mother, or on a field trip with the class. Examine and compare unwrapped and prewrapped produce. You might also wish to compare canned and bottled drinks.

The information card, Recycling, explains the importance of recycling our valuable resources. The free filmstrip, Recycling: An Ecology Study (see resources) would also be good for use here. The card, Recycling, also shows the steps that paper goes through to be recycled. If there is a recycling center in your area, see if you can visit it, or if an official will talk to your class.

Investigate local methods of disposing of trash. Is any effort made to recover valuable resources? To recycle materials?

Several of the resources listed for this card make good student reading.

Student Card #31

Student Objective: The student will be able to diagram the water cycle.

Conceptual Theme: Change and Adaptation

Materials:
water
dirt
glass
transparency, *The Water Cycle* (cover)
information card, *Measuring the Microclimate of a Habitat* (54-6)
ice cubes
shallow dish

Teaching Suggestions: The experiment suggested here shows the way nature transforms water into water vapor and then condenses the water vapor back to clean water. The dirty water is used to show how this process converts river or pond water back to clean water. Be sure the students are aware of the fact water vapor is invisible. Fog, clouds, and rain are condensed water vapor and are visible.

The water cycle is an important cycle in nature. Evaporation requires energy; hence, the amount of evaporation increases with increases in temperature. Through evaporation, water is returned to the air. Condensation is an energy-releasing process (that is why a steam burn hurts!); decreasing temperatures favor condensation. Through condensation, water is returned to the earth. To aid in a discussion of the water cycle, you may wish to make a transparency from the cover. *The Water Cycle* is an 11-minute black and white film available from the county film library.

Humidity is the amount of water vapor in the air. Relative humidity is a comparison expressed as a percent:

$$\text{relative humidity} = \frac{\text{amount of water vapor in the air}}{\text{amount of water vapor in the air can hold at that temperature}} \times 100$$

The comfort index is an expression that relates relative humidity and temperature to human comfort. Students who are interested in measuring relative humidity may be referred to the data card on "Habitat," an encyclopedia, or earth science text.

Student Card #32

Student Obejctive: The student will be able to show, by means of a diagram, at least two ways impurities can be removed from water.

Conceptual Theme: Change and Adaptation

Materials:
containers for water
salt
dirt
balance
information card, Waste Water Treatment (37-4)
sand
gravel
gallon can

Teaching Suggestions: This card focuses on ways impurities can be removed from water. Several of the simple methods involve filtering and evaporation. These same methods are used in nature in the water cycle. Water evaporates, condenses, and then perculates through the layers of soil and rock into the underground water table. Man then taps these layers for use. The obvious disadvantage to this process is that it is very slow. Man's need for water far exceeds the natural purifying processes. Not all materials can be removed by filtering, a point that is illustrated by the salt solution.

Evaporation will remove the salt from the water. If carried out correctly, all of the salt should be recovered. Again the disadvantage to this process is that it is slow. It is also costly, since it requires the expenditure of energy.

Other impurities are usually removed by the addition of chemicals. Chlorine is added to kill germs in the water. Water-hardening minerals may also be removed or exchanged.

The card on water sources in your area makes a good follow-up for this card. It shows how these and other processes are used in making local water sources suitable for drinking.

Student Objective: The student will be able to carry out and explain the distillation of salt water.

Conceptual Theme: Change and Adaptation

Materials: ocean water or salt solution (one quart)
information cards, Commercial Desalination (33-1) and
How to Build a Solar Still (33-3)
materials for solar still (see 33-3) or hot plate, teapot,
piece of glass, container for collecting water

Teaching Suggestions: This card explores the possibilities of using the ocean's water for drinking purposes. The cover for the card offers an introduction by showing the percentage of water available for use. With the world population increasing explosively (see cards on population), scientists are trying to find practical ways to desalt sea water. Most of the processes known are slow and expensive.

If you do not live near the sea, you can make your own salt water by adding salt to tap water. Have the students taste the water before they begin. If this is an individual activity, the student might wish to try the solar still. If larger numbers participate, it is faster to use the hot plate and teapot. Caution the students to be careful, as steam burns are extremely painful. The piece of glass can be placed above the spout of the teapot. The steam will condense on the glass and run down it. It can be collected in a glass or bowl.

The information card, Commercial Desalination (33-1) discusses other ways being used to desalt water. All methods are based on the different properities of salt and water: boiling point, freezing point, movement across a membrane. The students may be able to find other, new methods by consulting other references.

Encourage the students to experiment by designing a solar still of their own.

Student Objective: The student will be able to trace his drinking water from its source to his house.

Conceptual Theme: Change and Adaptation

Materials:
- samples of rain water, tap water, and well water
- baby food jars
- liquid soap
- hot plate
- pH paper
- information cards, Water Sources in Brevard County (34-1) and Water Surpluses and Deficiencies (34-5)

Teaching Suggestions: This card can be done on an individual or small group basis. The students should begin by formulating a list of questions they wish to find out about their water supply. Then they should contact the water department or department of agriculture in an attempt to get answers for their questions. At this point, you might want to consider a field trip to a local water treatment plant or a visit to the class by a resource person. The information card, Water Sources in Brevard County, gives a summary of the sources and treatment of water in this area. It also explains why some of the treatments are necessary.

The other ways to look at it section gives the student an opportunity to investigate aeration, hardness, and pH. Aeration is the process of adding air to the water. This keeps it from having a flat taste. The students should contrast the two in their experiment. Hardness of water is due to dissolved minerals in the water. Some water treatment plants soften the water before it reaches you. In other areas, homeowners find it necessary to soften the water themselves. The pH of the water has to do with whether the water is acid or alkaline. Materials with a pH less than 7 are acidic. Examples of such materials are vinegar, citrus juices, and soft drinks. Materials with a pH higher than 7 are alkaline. Examples of such materials include bleaches, soaps, and ammonia.

The card, Water Surpluses and Deficiencies, gives students a national outlook at our water picture. As the map shows, many areas of the U. S. will be in real trouble if they continue to grow.

The information card on the following pages, Florida's Water Supply, explains some of the problems peculiar to Florida. If you wish, you may reproduce portions of this card for the students. Since the information is fairly technical, you may simply discuss the contents with the students. In order to truly understand the limitations of Florida's water supply, some of the information contained in the card is essential.

Student Card #34

Florida's Water Supply

Florida's water supply comes entirely from precipitation that falls on Florida, southern Alabama and southern Georgia. As the water falls upon the ground, it may run off as surface water, be held in the soil, percolate to ground water, or be held in existing bodies of water. Surface water is water which occurs above the surface of the ground; ground water is that part of the water which is below the ground.

In the northern and northwestern parts of the state, in addition to local rainfall, water flows in from major rivers originating in Alabama and Georgia. This area has ample ground water reservoirs which are recharged by local rainfall and by groundwater inflow from these rivers. The limits of this area extend as far south as Levy, Marion and Volusia counties.

On the lower two-thirds of the main peninsula of Florida surface streams flow outward in all directions from the Green Swamp area in northern Polk County. All of this flow originates as rain on the area.

Underlying nearly all of Florida is a very thick section of permeable limestone containing water under both water table and artesian conditions. This formation is known as the Floridan Aquifer. An aquifer is a name of a layer of rock which holds and carries water. The word aquifer comes from two Latin words aqua, meaning water, and ferre, to bring. The aquifer brings water under ground and is an underground layer of rock which is a good source of water. An aquifer may be a layer of gravel or sand, a layer of sandstone, or permeable limestone. Underneath the aquifers, everywhere at the same depth, is a layer of rock that is impervious, or watertight. The flow of the groundwater roughly approximates the flow of the surface water.

The Floridan Aquifer yields good quality water except south of Lake Okeechobee and in parts of an area along and east of the St. John's River. The Floridan Aquifer south of Lake Okeechobee contains trapped, highly mineralized water. There are available evidences at other points that indicate that water is being withdrawn faster than it can possibly be replaced.

The Biscayne Aquifer is located in the southeast area and lies immediately below the surface. It is one of the most productive underground reservoirs known to man, but it is limited in area. This aquifer presently serves a population of nearly 2 million people.

Salt water intrusion occurs when a body of salt water invades a body of fresh water. It can occur either in the surface or ground water. Intrusion takes place when salt water and fresh water are either in direct contact or separated by a relatively permeable aquifer. This condition exists throughout much of the perimeter of Florida as the ground water of the coastal lowlands is separated from salt water by formations that are porous and permit the passage of water quite readily. Sea water is heavier than fresh water and when the two come together in a permeable formation there will be a tendency for the heavier sea water to displace the lighter fresh water.

There are several factors that are responsible for salt water intrusion. (1) Increased demands by cities, (2) increased demands by agriculture, (3) increased demands by industry, (4) excessive drainage, (5) improper location of wells, (6) uncapped wells and leakage, (7) abandonment of artesian wells.

Salt water intrusion may be combated by storing water in surface reservoirs over recharge areas and by putting salinity dams in some of our streams and canals. A law passed in the 1963 Legislature requires the establishment of salt water barriers and new canals after the State establishes a salt water barrier line.

The Division of Interior Resources has made recent studies which indicate very definite limitations on the availability of water. These studies indicate that North Florida has more than sufficient water to care for all uses at least through the year 2000. The three areas where water requirements may most likely exceed water availability are: (1) the Cape Kennedy area,(2) Southeast Florida including Monroe, Dade, Broward and Palm Beach counties (3) the Pinellas-Hillsborough county area. There is sufficient water available to meet the needs in the adjacent areas during the next 50 years provided consideration is given to these needs in planning water management projects. Consideration must be given not only to the projects within these areas of need but in adjacent areas from which surplus water is to be obtained.

Resources:

In Depth Report, Central & Southern Flood Control District, Volume I, No. 3 (March 1972). Free upon request.

McQuillan, H. R., Water, Florida Department of Natural Resources. Free upon request.

Student Objective: The student will be able to report to the class the amount of water his family uses in one month.

Conceptual Theme: Interaction and Interdependence

Materials:
notebook
old water bill
information card, Saving Water (35-1)

Teaching Suggestions: If this is done as a class discussion you may want to make a transparency of the cover to stimulate discussion. The cover points out that Americans as well as the rest of the world are using water faster than the water cycle can replace it. Some scientists believe we are using water twice as fast as it can be replaced.

Have the students place tally sheets at various places in their home where water is used. Have each member of the family put a mark each time they use the water for the listed purpose. At the end of the day add up all the marks for each of the activities and write them in the notebook. Be sure to keep the records over a complete week since more water is used during the weekends when everyone is home. When the data is completed, have the students bring their notebooks to class and figure out the number of gallons each family used for the days of the week.

Additional activities would include figuring the amount used per month and per year.

Other math activities you might include --

1. water cost/gallon
2. total amount of water per family
3. compare the total from the chart (for a month) with the figure from the bill
4. make a graph comparing water usage in gallons against the number of families in each bracket

This is really a project for the whole family. The information card, Saving Water, can be discussed at home as well as in class. Perhaps your class will want to start a water saving project.

Student Card #36

Student Objective: The student will be able to show, by means of a chart, all the ways one local business uses water.

Conceptual Theme: Change and Adaptation

Materials: information cards, Stop The World, I Want To Get Off! (36-1) and
Brevard's Oyster Industry May Be Dying Out (36-3)
notepad or clipboard
paper and pencil
crayons
glue, scissors, magazines, construction paper

Teaching Suggestions: This card can be done on an individual or small group basis. It looks at the total water usage picture and draws attention to the rising consumption of water. The information card, Stop The World, I Want To Get Off! gives the students some background information on water usage and nature's recycling system.

The clues for you section can be done a number of ways. You may want to assign different groups the task of researching different businesses to determine their usage of water. You might also want to invite resource people to talk to the class about the way their business uses water. Don't forget agribusinesses; they are large users of water and their runoff is particularly important. Other places to visit could include local manufacturing concerns, local supermarkets, fire departments, hospitals, schools, restaurants, and sewage treatment plants. The teacher will need to make advance arrangements for the students' visits. It might be a good idea to have the students write ahead of time with a list of questions. This way, the business representative can have the information ready.

A balanced aquarium is hard to set up. The top of the aquarium needs to be sealed and air tight to make a truly closed environment. Do not get too many fish in the tank and be sure to include a scavenger fish. The plants need to be fresh.

A visit to Grant, Florida to see the oyster industry in action would be a food field trip. If the timing is right the trip could include the Grant Seafood Feastival, held each year in the early spring. Areas other than Brevard County should select one water-dependent industry to research.

Student Objective: The student will be able to show by means of a diagram, the processes involved in the reconditioning of waste water.

Conceptual Theme: Interaction and Interdependence

Materials: student information card, Waste Water Treatment (37-4)
student information card, The Water Cleaning Machine (37-1)

Teaching Suggestions: This card works best as a group investigation. Students can be divided into inquiry groups. Waste water is becoming more and more of a problem as the population of an area grows. In the state of Florida, much building and development has been halted until cities and developers can provide adequate sewage treatment. The following activity card and related information cards give information on standards set for waste water effluent.

In order for the students to understand waste water treatment, they will need to read the information cards before they proceed. Be sure they understand the terms organic pollutants, primary, secondary, and tertiary treatment; effluent. These and other terms are explained in the information cards.

Once the students understand the basic processes involved in the removal of organic and non-organic wastes, have them investigate the treatment waste water gets locally. The questions listed in clues for you should serve as a guide for their investigation. Have them decide whether the treatment is adequate in their area.

This would be a good time for a field trip to a waste water treatment plant. In Brevard County, the plant at Cocoa Beach is available for tours and is an example of a plant that gives tertiary treatment of sewage. The students should go in groups of 10-15 and be prepared to ask questions. If you cannot take your students on a field trip, see if you can get a sanitation engineer or someone from the sewage treatment plant to talk to your class.

Student Card #38

Student Objective: The student will be able to show, by means of a chart, governmental responsibilities for clean water.

Conceptual Theme: Change and Adaptation

Materials: information card, Water Quality Standards (38-1)
information card, Local Standards (38-3)
information card, We Need Clean Water (38-4)

Teaching Suggestions: This can be done as an individual, small group, or class activity.

Students could be divided into research teams and exchange information found. This is a good time to have someone from the class write to legislators, congressmen and pollution control agencies for information.

Call or write for information or resource speakers from your health department, water sanitation engineers or local land planning commission.

County and state agencies: Florida Water and Pollution Control Operators Association--Region Three, Department of Air and Water Control, Division of Health.

Students from the local high school ecology classes could be asked to demonstrate the methods for testing water to determine if it is pure. Some of the junior high and middle schools also have equipment to test the water. Test kits are available commercially to test for dissolved oxygen, phosphates, human waste, etc.

Many of the resources listed for this card are free (see references). If you decide to use them, be sure to allow at least a month for arrival.

Since the board of health plays a major role in enforcing clean water standards in the state of Florida, this would be a good time to have a resource person from the department talk to the class. Be sure to tell the speaker ahead of time the questions you would like answered. You might also want to consider someone from the state pollution control board, although their time is more limited. This is a good time for career awareness. There are a number of occupations that tie into water quality control and enforcement.

Student Card #39

Student Objective: The student will be able to show, by means of a diagram, the oxygen-carbon dioxide cycle.

Conceptual Theme: Change and Adaptation

Materials:
- powered yeast
- hydrogen peroxide
- test tubes
- glass beaker
- matches
- vinegar
- wood splints
- water
- information cards, Oxygen-Carbon Dioxide Cycle (39-1) and Carbon Dioxide (39-2)

Teaching Suggestions: Originate the activity by having the students read the information cards listed. This should give them some background for understanding the producers and consumers of oxygen and carbon dioxide in the biosphere. As the card points out, the amount of carbon dioxide in the atmosphere has been on the rise since approximately 1955. This is due to the tremendous increase in the amount of fossil fuels burned. The students might want to make a list of all the things they use each day that it took fossil fuels to produce. They may be surprised.

After the students have completed the activities under clues for you, discuss the significance of the oxygen-carbon dioxide cycle. The part that green plants play in the process is discussed on earlier activity cards (see index). Carbon dioxide is taken into the green plant and used in photosynthesis. The carbon goes into simple sugars and starches. The oxygen given off by the plant comes from water that is used in the photosynthetic process. Animals take in oxygen and use it in the production of energy from food (respiration). The carbon dioxide given off is a by-product of that process. This cycle can be illustrated in a number of ways. Perhaps one of the best illustrations for the classroom is a balanced aquarium.

At the present time, our largest producer of oxygen is the ocean. Students might want to discuss what will happen as the ocean becomes more polluted.

The two experiments under other ways to look at it are set up the same way. If they are performed by the students be sure they exercise caution with the flame. They may also need to practice inverting the tube without spilling its contents before they actually start.

Student Objective: The student will be able to list the characteristics, percentages, and causes of five pollutants in the air, as well as methods to reduce these pollutants.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, What's in the Air (40-1),
We Need Clean Air (40-2), Local Standards (38-3)
pencil and notebook
ditto and blank graphs

Teaching Suggestions: This activity can be done as a small group or independent activity. If the student works independently, he will need to know how to graph data. You can use the blank forms provided for the bar graphs. If the students need help, assist them in the making of the graphs. If they work in groups, they may wish to make large graphs for display in the room.

Discuss the graphs when completed. The information given is for the whole United States. What do you think is the largest local source of pollutants? How bad is air pollution in your area? Call the local board of health or air pollution control agency for answers to these questions. Activity cards on the automobile and production of electricity will provide follow-up pollution sources.

A temperature inversion occurs when a layer of warm air settles over a layer of cold air, trapping the cold air close to the ground. The pollutants are trapped with the cold air posing a health hazard to the people of that area.

Local rules regarding air pollution are set by the Board of County Commissioners and the State Board of Health. Violoations should be directed to the local Board of Health. Regional air standards are set by the Environmental Protection Agency.

You may wish to make the discussion in other ways to look at it a class activity. Assign parts to groups of students and let them prepare their case. Let a spokesman from each group argue their case with the mayor.

You may wish to combine this activity with the other cards on air and air pollution (see index).

Student Objective: The student will be able to measure and report the particulate levels of air pollution in his community.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, What's in the Air? (40-1) and Ringelmann Smoke Chart (41-1)
index cards
white petroleum jelly
microscope or hand lens
ruler

Teaching Suggestions: This card can be done as an individual or small group activity. If several groups participate, you may assign an area for each group to research. If you have paper that is already gridded in squares, you can simply paste it to cards. The students should select the sites for their cards carefully and anchor the cards so that they do not get blown away or distrubed. They will need to make a map of the area they are measuring, noting the location of each card, as well as important things around each card. If they need help in mapping techniques, consult the information card, Making a Map (see index) or one of the references.

The students are directed to count every square on the card. If this becomes too time-consuming, you could have them sample squares and average their data. If they follow this method, they may require some help with the calculations. When the students interpret their results, they will need to consult their maps for possible sources of particulate pollution. Remind the students that they are only measuring one type of air pollution—particulate matter. Consult the information card, What's in the Air? (see index).

Children might also assemble a series of pictures showing air pollution. Pictures of the sky over cities like Detroit, Pittsburgh and Chicago should show this well. Newspaper stories on California's smog problem should also help build interest. Student photos of local air pollution would be interesting. Authority for setting local ordinances is given to the Board of County Commissioners. Violations should be reported to the health department.

If your students are interested in another way of measuring particulate matter, try using a Ringelmann Chart. The mathematical calculations involve averaging and percentages. Use the information card, Ringelmann Smoke Chart (41-1).

Student Card #42

Student Objective: The student will be able to list steps being taken to reduce automobile emissions.

Conceptual Theme: Interaction and Interdependence

Materials: information card, Alternatives to the Internal Combustion Engine (42-1) and Professor Clean Asks, What is Air Pollution? (see references)

Teaching Suggestions: The amount of gasoline used by the family may be recorded on last year's income tax form. Have the students check this source before doing the computations. Compute how much each family produced in the way of automobile hydrocarbons last year. Then find the total amount the families representing the class produced. You might want to continue and figure out how many pounds of hydrocarbon the families of the school contributed to polluting the air of your city. This figure sometimes brings home the idea of the millions that are on the road daily polluting the air.

Current literature has had many suggestions for ending the gas crisis by providing many tips on how to save gas. The students should have no trouble in finding material on this subject.

The resource, Professor Clean Asks, What is Air Pollution? (see references) lists equipment cars are being outfitted with in an effort to fight pollution. You can probably get this information from a car dealer, also.

The information card on engines gives the student the chance to compare the leading alternatives to the internal combustion engine. It might be interesting at this time to visit a Mazda dealer. The Honda CVCC engine also is an interesting idea. Try to arrange a field trip to visit a dealership. A regular auto mechanic could be asked to give ways to increase the efficiency of the internal combustion engine.

There are several resource books available. The Troublesome Tail Pipes gives information on the internal combustion engine and the use of liquid propane. It also contains suggestions for additional activities.

Student Objective: The student will be able to list at least three methods of transportation and the effect each method has upon the environment.

Conceptual Theme: Interaction and Interdependence

Materials: map of community (available at your local Chamber of Commerce)
data cards, Transportation (43-1) and Land Use (43-2)
graph, Decline in the Use of Mass Transit (43-3)

Teaching Suggestions: This can be done as a small or large group activity. Before the activity starts, obtain a map of your community from the Chamber of Commerce. If several groups are participating, you may need to make arrangements for additional adult supervision. Divide the class into groups and assign each group an area to survey. Decide ahead of time what symbols you will use for each of the things mapped. After the class has completed their map, post it and discuss it.

After the class discussion, have the students regroup to fill out the data card on transportation. Let the groups discuss and justify their answers. Have the students study the card, Land Use. What is the most efficient means of transportation?

Before you study the graph on mass transit, you may need to define the term for your students. Mass transit is any system that moves a large number of people. Mass transit, as the graph shows, reached a peak in 1945. Since then, all forms of mass transit have declined. Availability of cars, fuel, and good highways have all contributed to this trend. Now, with gas and cars becoming more expensive and highways becoming more crowded, mass transit may become more popular.

Find out about mass transit in your area. Call the local transit authority for information about routes, usage. Survey the people in your area about mass transit. Decide, as a class, what to do with the results.

The bike path information may be collected from the map under clues for you. Debate the pros and cons of building more bike paths in your area.

Student Objective: The student will be able to express his feelings about nature using a method of his choosing.

Conceptual Theme: Similarities and Differences (Patterns)

Materials:	information card, Writing Haiku Poetry (44-1)	
	water colors	water color paper
	art materials	brushes
	magazines	scissors

Teaching Suggestions: This card can be done individually or in small groups. The object of this card, of course, is to have students express their feelings about nature. If you introduce this card early in the year, the students can use the techniques contained throughout the year.

Perhaps you can get the students started with some pictures or examples or time outside the classroom. The cinquain is easier to write than the more sophisticated Haiku, but your students may surprise you. Examples of cinquains are given below; examples of Haiku are given on the information card.

Provide the students with art materials to accompany their writings. Water colors and chalk drawings are particularly pretty with the poems. If the poems are written on 3 x 5 cards, they can be mounted on the artwork.

One group may want to try the bulletin board. America the Beautiful is one song that is easy to do. Have the students try to find pictures directly relating to happenings in the environment (oh, beautiful for spacious skies—pictures of air pollution, smog).

— Examples —

Air
Smoggy, smelly
Breathe, gasp, choke
We need cleaner air.
Pollution

Weather
Blowing, thundering
Snow, rain, blow
The weather always changes.
Winds

Pollution
Water, air
Smog, soot, mess
No air to breathe.
Death

Pollution
Cars, factories
Litter, smoke, damage
Bad for our health.
Deadly

Mountains
Small, large
Erupt, flow, slide
Mountains are all sizes.
Hills

Natural
Beautiful, deserted
See, hear, smell
Untouched areas are beautiful.
Peaceful

Student Card #45

Student Objective: The student will report on 3 ways electrical energy can be conserved by selective consumption.

Conceptual Theme: Interaction and Interdependence

Materials: electric bills for 3 months
information cards, Saving Electricity (45-1) and
How To Understand Your Electric Bill (45-3)

Teaching Suggestions: Power shortages and problems of increased power use have become national news. This card focuses on electrical consumption in the home, since this is the easiest area for observation. Most homes, like businesses and schools, waste a great deal of energy.

This card can be done as an individual or group activity. The first thing the student must be able to do for this card is to read an electrical bill. The unit for measuring electrical energy is the watt. A kilowatt is 1000 watts. A kilowatt-hour is 1000 watts for one hour. The unit in which your bill is expressed is kilowatt-hours. The information card, How To Understand Your Electric Bill (45-3), should help the students in reading their electric bill. The first thing they need to do is find the number of kilowatt hours used on the last three electric bills. Total the number of kilowatt hours and divide by three. This will give the students an average. In areas where electrical consumption is seasonal, you may need to have three bills from different seasons. In Florida, for instance, the students might need to have bills from summer and winter.

Have the students try to reduce the amount of electricity used in their home. The information card, Saving Electricity, as well as sone of the references should help them. Florida Power and Light also furnishes free booklets on conserving electricty. You can also request a representative from the power company visit your class. Make a list of suggestions they can try at home. At the end of a month, have the students compare the number of kilowatt-hours used. Be sure that the students note the date on which the meter is read so their month can begin that day.

The following card (#46) gives some information on the different sources of energy. All of these can be harnessed to produce electricity. The problem at the present is that some of the cheaper sources (like coal) are very dirty. Other inexpensive sources (like hydroelectric) are limited in their availability. The are several good films on energy sources. (see references).

Student Card #46

Student Objective: The student will debate alternatives to energy shortages and state possible solutions.

Conceptual Theme: Change and Adaptation

Materials: information card, Our Energy Crunch (46-1)
graphs: Total U.S. Consumption of Energy By Source (46-5)
The Oil Gap (46-4)

Teaching Suggestions: This activity will need a fairly large group in order to succeed. Divide the class into groups and assign parts. Each group is responsible for researching their position on the topic. For instance, the energy producers might ask for off-shore drilling, greater use of coal, and more nuclear power plants. The environmentalists would need to answer these demands with their effect on the environment. The government would then have to decide whom they favor in this discussion. You may wish to have those not directly involved in the debate act as a legislative body, voting on any proposals that come out of the committee. Be sure that each group is thoroughly prepared before the debate and that they have designated someone as their spokesman (or woman).

Research is constantly being conducted to develop new sources of energy. Geothermal and solar energy are two types that have been used experimentally, but not on a large scale.

The graphs given indicate some of the reasons for energy shortages. The first is the shift to oil as the primary energy source. Thus, demand for oil has risen. Another reason for this rise is not given on the chart: the world population is increasing, as is technology. The second reason is that oil production has stayed fairly steady. This has caused an energy gap.

You may want to schedule a visit to a power plant to see how electrical energy is produced in your area. If there is a refinery, coal mine, or oil well in your area, you may wish to visit it also.

In letting the students design their own power plant, let them go. Someone may suggest using a wind mill to produce power when the wind is blowing and storing it in large batteries. Do not discourage them just because the batteries have not been made yet that will store that much. Let their imagination go wild.

There is a great deal of information being produced on energy. Some suitable material is listed in the references; consult bibliographies for additional ones.

Student Card #47

Student Objective: Based upon data collected, the student will be able to state how noise affects simple learning.

Conceptual Theme: Interaction and Interdependence

Materials: copies of maze (three per person) (47-2)
watch or clock with second hand
ditto of blank graph (47-1)
information cards, Noise is an Invisible Pollution (47-3) and Noise (47-4)
casette recorders, tape, earphones

Teaching Suggestions: This activity will need at least seven participants to succeed; more are desirable. Some planning is necessary before the beginning of the experiment in order to assure a tape with a high noise level. The teacher can make one using hammers, whistles, etc.

The student leader should divide the rest of the participants into two groups: experimental and control. (Some effort should be made to make sure the students in each group are of equal learning ability.) The control group should be allowed to complete the experiment under quiet conditions. Each student should complete three mazes, with times kept for each trial for each student. Mark the trials first, second and third and record the time on each. After the trials are complete, average the times for each group on the first trial, the second and the third. Record this data on the blank graph. If the group is typical the time to complete the maze should be shorter with each trial.

The experimental group should be constantly interrupted with loud noises: banging, doors slamming, loud music on and off. You can use a tape on earphones, or put these students in another room. Record and average the data. The big question is: did the noise make a difference? Did the students in the experimental group average longer times on each trial of the maze? If so, could anything else besides the noise have made a difference? The students should reach their own conclusions.

Student Card #47

The table below shows the common ranges and responses for many noises. Noise levels are measured in decibels with 0 being the threshold of hearing. Prolonged exposure to noise causes permanent hearing damage. The students should survey their community for jobs that have a high noise level. The card, Noise is an Invisible Pollution, tells what the federal government is doing to combat noise. The card, Noise, tells what one community is doing to combat noise. Is your community doing anything?

Example of Sound	Decibel Range	Human Response
Breathing	10	Audibility
Whisper	30	Quiet
Average residence	40	Comfort
Normal conversation	60	
Rush-hour traffic	80	Annoying
Subway	100	Prolonged exposure causes damage to hearing
Jet airport	120	Discomfort
Discotheque	130	
Shotgun blast	140	Pain
Jet plane	150	

Student Objective: The student will be able to show, by means of a drawing, how one animal in the environment affects him directly and indirectly.

Conceptual Theme: Interaction and Interdependence

Materials:
- references on listed animals
- drawing paper
- pen or pencils
- colored pencils

Teaching Suggestions: Man considers many animals pests simply because they interfere with his daily activities. He forgets to look at the total picture to see how this animal fits into the pattern of interaction. The object of this activity is to have the student research at least one animal and to make a judgement as to whether or not this animal presents a problem. Even though some animals may be considered a pest to man, they may represent a very important link in an ecological relationship.

This activity can be done individually, by small groups, or the entire class. You may want to add animals of your own to the list. It would be a good idea to tie this card to the card on food webs (see index).

This study may lead into a discussion of the ways man attempts to control pests. If this happens, this would be a good time to introduce the card for the debate over pesticides.

The question about plants is particularly appropriate for many areas of Florida, since there are so many poisonous and irritating plants. The Department of Agriculture in your area probably has pamphlets which can be of help to the students in their research. In Florida, you may want to invite someone from the mosquito control agency to talk to the class about natural as well as chemical methods of controlling mosquitoes.

Student Card #49

Student Objective: Based upon data collected and research, the student will be able to make recommendations concerning pesticide use.

Conceptual Theme: Interaction and Interdependence

Materials: newspaper articles and books dealing with pesticides
information cards, The Scientific Investigator (13-1)
Brown Pelican (49-4), Pests—Some We Need, Some We Don't (49-1), Using Natural Controls (49-7)

Teaching Suggestions: The students need to read the card on designing an experiment before they start. Keep in mind that a good experiment has some kind of control. Be sure they design this into their experiment. Garlic, onion, mint, and marigolds make rather good natural pesticides. There are some people who spray their gardens with soap or detergent and claim this keeps the bugs away.

After your students have reached conclusions about their pesticide experiment, have them read the information cards, Pests—Some We Need, Some We Don't and Using Natural Controls. Do you think the people in your community use pesticides without exercising enough caution? Do they use pesticides too frequently? Do they use the persistent pesticides? The students might wish to contact farm and garden supply stores for a list of the pesticides they sell. With the store's permission, they might take a survey of the people buying pesticides. Ask if they can hand out copies of the list of safe pesticides. The students might also like to conduct a survey in their neighborhood. Find out what pesticides are being used and how they are being used. Decide what to do with the results of your surveys.

For the debate, assign parts to each group of students. Team members may contact people such as grove or orchard owners, mosquito control people, the health department and conservation groups. The railroads and road maintenance crews are now spraying right-of-way for weed control. All of these groups should be represented at the simulated hearing. Allow the groups enough research time to adequately present their case.

The EPA has a packet of free information on pesticides. See the references on this card for further information.

Student Objective: The student will be able to show, by means of a diagram, how a closed environment works.

Conceptual Theme: Interaction and Interdependence

Materials:

paper and pencil	drapery ring
bread	oaktag
tissue paper	glue
tempra paint	dried flowers (optional)

Teaching Suggestions: You might want to start this activity by having the class talk about the things any plant and animal needs for survival. Follow this discussion by asking the students to design a closed environment for aquatic animals. If fish are used, the students must prepare for food, enough plants for oxygen, as well as scavengers to clean the uneaten debris, and decomposers. This will require some research on their part. They will also need to know the best temperature for that animal. Check carefully to see that the student has listed all the possibilities for care.

Terrariums are more difficult to keep going. If the student chooses a land-dwelling animal, he must research carefully the needs of that animal. Temperature and moisture requirements as well as food and plants must be kept in mind. Some of the insects might prove to be easier than the higher animals, such as toads or mice. Leaf-eating insects might be easiest.

The students may want to make mini-models of the habitats of various animals. The following example shows how one can be done for a butterfly:

1. Start with a drapery ring.
2. Cut oaktag to fit the back of the ring.
3. Cover the oaktag with fabric or tissue-collage a background. (Example: blue for sky.)
4. Add plants for that animal. (A few, small, dried flowers in this case.)
5. Make the animal from bread clay. (Directions and recipe follow.)
6. Attach animal to background.
7. Glue background to ring.

— Bread Clay —

1 slice bread (crumbled, or torn in small pieces)
1 scant tablespoon Elmer's glue

Mix until the consistency of play dough.

Note: heaping teaspoon can be used in place of scant tablespoon.

Clay made from bread and Elmer's glue makes a medium that is plastic and very durable. It will not fall apart due to air moisture, or crumble easily. It can be used for very delicate objects, like flower petals, or heavier ones like mushrooms. It can be heated or used plain. If refrigerated it will stay in soft form indefinitely, but in air it dries and turns firm quite rapidly. It can be dyed by the addition of tempra paint while mixing, or it can be painted when formed and dried. If white clay is desired, merely omit the bread crust.

Student Objective: Using pictures given him, the student will be able to arrange them in a food chain.

Conceptual Theme: Interaction and Interdependence

Materials:
- magazines
- scissors, glue, pen
- information card, Niches (51-1)
- United States Map
- ditto of food chain parts (51-3)

Teaching Suggestions: This is an independent or small group activity. This card gives only a brief overview of food chains. If your students need more background, consult the set of primary cards first. They contain several cards on food chains, food webs, and food pyramids.

Originate the activity by having students list everything they ate for one meal. Take each food and trace it back to the original source. For instance, hamburger: cow, grass, sun. Do this for each food until the list is complete. For baked goods, take the major ingredients, as flour, sugar, shortening. When the list is complete, have the students make posters depicting the food chains. They can do their own drawings, or use magazine pictures.

When they have finished the posters, have them read the information card, Niches. The niche is the role or job a plant or animal fulfills in nature. The role of producer, or maker of food, is filled by green plants. They alone have the ability to turn energy from the sun into food energy. The role of consumers is filled by the animals. They consume, or eat, the food that is produced. Consumers can be further divided by the type of food they eat. Herbivores eat only plants, carnivores are meat eaters, and omnivores eat both plants and meat. Decomposers break down, or recycle plant and animal waste. Other niches that are discussed on the card include parasites, predators and scavengers.

One of the optional activities centers on decomposers. Perhaps the easiest decomposers to spot are mushrooms or toadstools. Others the students might look for include snails, earthworms.

If you wish to stress adaptations for hunting, the John Young Museum and Planetarium in Orlando has an Eye Exhibit. The exhibit is on comparative anatomy of the eyes of animals with emphasis on importance of sight to animals hunting for food. A lecture on eyes is given two days a week.

There are also optional activities that focus on art, science, language arts and geography. Each group may want to select a different activity. The mapping activity could easily involve the whole class.

Student Objective: Using a poster, the student will be able to trace the pattern of interaction in a food web.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, A Simple Food Web (52-11) and Niches (51-1)
construction paper
felt tip pens or crayons
roll of string (optional, for teacher demonstration)

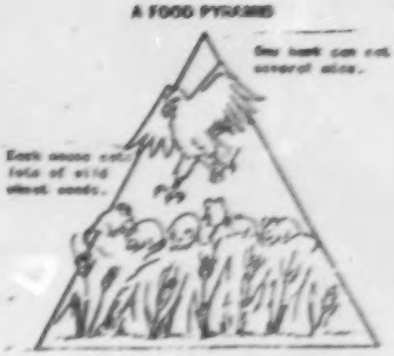
Teaching Suggestions: Simple food chains as discussed on the previous card rarely exist in nature. What does exist is a food web. Food webs show the interaction between food chains. They also show the interdependence between food chains.

Originate the activity by having the students study the information card, A Simple Food Web. Have them trace the pattern of interaction in a food web. After you are sure they understand the basic concept of a food web, have them construct their own food web using a local animal. It may take a bit of research to complete the food web, so do not think you have to be an authority. The Audubon Chart Series on food chains would be helpful here.

To illustrate the interdependence of the animals in the food web, try this optional class activity. Before class, make name tags for the students using the names of plants and animals. Try to include producers, consumers, and decomposers. Give each student a name tag and ask them to sit in a circle. You can start anywhere, just pick a student at random. Give that student the end of a roll of string. Ask the question, "What eats this animal?" After the group has identified the animal that consumes the first, run the string from the first student to the second. Continue with this procedure until all the students have been worked into the web. You may need to change the question slightly for producers and decomposers by saying, "Who uses the energy from this animal?" To illustrate the interdependence of the animals in the web, ask, "Who will be affected if this animal is killed?" Have each student who is connected to the first drop the string. Every other living thing in the web is affected.

The food web canopy listed in other ways to look at it is a striking class project. You can use the food web on the information card as your model or one of your own. Divide the class into groups. Make a wire frame for each animal or plant in the web. Don't forget the sun. Cover the frames with tissue paper. Hang the completed frames from the ceiling. Then, using colored yarn, connect the animals into a food web. This web forms a canopy over the classroom.

Student Card #52


A FOOD PYRAMID
One hawk can eat several mice.
Each mouse eats lots of wild plant seeds.

This drawing, which is taken from the primary set of cards, illustrates a food pyramid. The pyramid illustrates how the numbers of each consumer is limited by the food source directly below it. It also illustrates that the higher one travels up the food pyramid, the fewer animals (or smaller mass) it can support. This is one of the natural limiting factors for any population.

Student Objective: The student will be able to state the importance of predators.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, Coyote—Still Scourge of the West (53-1)
and Wolves are Necessary (53-3)
notebook and pencil

Teaching Suggestions: This card can be done as an individual or small group activity. Predators, like other groups, occupy an important niche in nature. Many predator populations are declining because they are being hunted and killed indiscriminately. Bounties are still paid in some areas to encourage the killing of predators. Farmers are one of the groups urging the continued killing of predators. Sheep farmers, particularly, claim predators hurt them financially.

Conservationists, however, point out that predators are not all bad and killing them is not all good. Predators kill animals that may be destructive to crops. They keep other populations within limits. Some predators are instrumental in maintaining natural communities.

The two information cards give opposing views on predators. The student must decide what action should be taken.

The optional activities center on the cover of the card. Have students read the information presented there before preceeding. This is an excellent illustration of the interdependence of living things. The students could repeat this activity for a plant in this area, or for an animal such as the alligator.

After the students have written the poem and found a picture, you may want to decoupage it. Directions are given on an information card (see index).

Student Objective: The student will be able to measure at least two abiotic features of a habitat and show how the conditions in the habitat relate to the living things there.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, Habitats (20-1), Partners (54-5),
Measuring the Mini-Climate of a Habitat (54-6),
Population Counts (54-3), and Habitat Survey (54-1)
materials listed on each information card

Teaching Suggestions: Ecology is the study of dependence and interdependence in the whole environment. By studying portions of a school area, field site, or home lawn in depth, the students will be made aware of some of the interdependent factors.

It is not essential that a teacher know all about a subject to be able to enthusiastically encourage the children to participate in these activities. In fact, it can be an asset to have little background in an area to be studied because then the teacher can honestly display interest, surprise, and enthusiasm for the new experience.

This is an outside activity. The teacher should read the field trip checklist before going out on the activity. This activity can best be accomplished by small groups working on one investigation. All of the investigations require advance planning and making of equipment. Have the students read the cards and decide which investigations they wish to do. The investigations on soil are quite extensive, so it may be necessary to choose which ones they can complete. Before the students begin their investigations, allow them to practice their measuring techniques. Be sure they have a clear idea of what they are to do and what data they are to collect.

The students should select a small, convenient habitat at first. A large tree is suggested. A small grassy area, sand bank or small pond will also provide measurable habitats. Optional activities include measuring other habitats and follow-up activities throughout the year. Have them summarize their findings on the card, Habitat Survey.

The students should at least do the habitat survey, a population count, a soil profile, measure the pH of the soil, measure the temperature and wind speed in the habitat.

This activity lends itself to large bulletin board or mural displays. Sponge painting is easy and looks good. Use a piece of sponge instead of a brush and dab the paint on. Draw in all the discoveries and post the habitat conditions on the board.

If one habitat you explore is the beach, use tempra paint or finger paint to decorate your windows with a mural of life on the beach. Other activities you might want to try include sketching plants and animals on the beach while you are there. How are these living things adapted for life on the beach. There are a number of art activities that you can do while you are at the beach and later in the room. You can make sand castings at the beach. To make sand castings, scoop out a shallow hole for the mold. Place in it things you collected representative of that habitat (sticks, sea weed, shells). Pour in plaster of paris and allow twenty minutes to dry. You can also make wind chimes and hanging planters out of shells found at the beach.

BIOTIC COMMUNITIES IN BREVARD COUNTY

Oceanic Regions
Beach Dunes
Inlets
Estuaries and Lagoons
Mangrove Swamps
Salt Marshes
Sand Pine Scrub
Pine Flatwoods
Hammocks

Information adapted from *Teachers Curriculum Guide for Field Ecology*, Brevard County Center for Environmental Learning, 1971.

BIOTIC COMMUNITIES IN BREVARD COUNTY
OCEANIC REGIONS

From the shoreline the ocean floor slopes gently away forming the continental shelf. On the Atlantic coast the width of this shelf is over 100 miles at Jacksonville, Florida. It grows more narrow heading south being about 26 miles wide at Cocoa and only a few miles in width at Miami. Two major habitat zones make up this region, the neritic zone, or open water above the continental shelf, and the littoral zone, the sea floor from the shore to the edge of the continental shelf. The depth of these waters varies from a few feet near the shore to over 100 feet at the edge of the continental shelf.

THE OCEAN BEACH: THE TIDAL ZONE

The beach is the longest, narrowest, and easiest to identify of all the communities. It is a ribbon of sand covered and then uncovered by the ocean's tides twice each day. The action of the waves keeps the tidal zone free of land plants while the drying action of the sun and air during low tides limits marine algae. Even so, a surprising number of different living things inhabit the beach.

In rocky areas* the marine algae cling to the bottom with well adapted holdfasts. Species found on our rocky shores include the limpet, the sea anemone, and the starfish.

Most of the beach is sandy, however, and many animal species have adapted themselves to this continuously changing environment. Of particular interest is a small mollusk called a coquina. This species and the sand flea prefer the wave-washed area of the beach. Here the wave action provides these species with a constant supply of plankton.** Both the coquina and the sand flea are a source of food for shore birds and fish. The shorebird species include the ruddy turnstone, the sanderling, and the knot. These birds are often seen during feeding, running up and down the beach following the wave action.

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*Most of the rocky area on our shores is composed of coquina, a cemented mixture of sand and sea shells. This is a geologic formation of the Ice Age that extends for 150 miles along the east coast of Florida. A small mollusk of the seashore is also known as a coquina.

**plankton — tiny, drifting or weakly swimming plants and animals

Another source of nutrition on the beach is wrack. Wrack consists of a great variety of dead and dying marine plants and animals cast up by the sea; it is also made up of upland vegetation that has been washed into the sea. Some living things in wrack include the massive floating brown algae, Sargassum, a great variety of dead fish; the long cigar-like seeds of mangrove tree and the colonial cnidarian, the Portugese man-of-war. Wrack attracts scavengers such as the nocturnal ghost crab and a variety of insects which feed on the dead organisms. The scavenger insects attract other insect species which feed on them, the most prominent being the tiger beetle, a beach species with large jaws and wings well suited for rapid controlled flight and is a common sight on warm summer days.

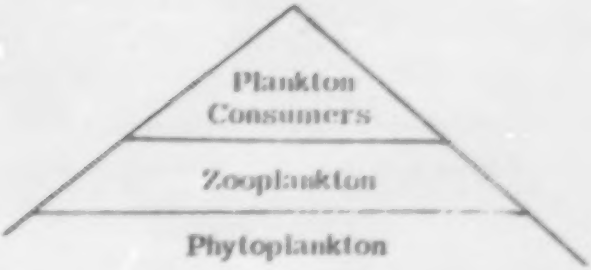
Man can also be found living on the beach. He uses it for sunbathing, recreation, and even as a thorough-fare for motor vehicles more and more. How will this affect the other living members of this complex community? We do not know.

Scientific Names:

coquina - - - - - - - - - Donax variabilis
sand flea - - - - - - - - - Hippa talpoida
ghost crab - - - - - - - - - Ocypode albicans

THE NERITIC ZONE

Most of the neritic zone allows the passage of enough light to support many phytoplankton, passively drifting or floating organisms that carry on photosynthesis. One type of single-celled phytoplankton is Gymnodinium brevis, the organism that causes red tides. Phytoplankton are the producers of the marine world and are the food base of this ecosystem. The first consumers of these microscopic forms are marine zooplankton which includes adult crustacea (copepods), larval invertebrates, and protozoa. Other consumers of plankton include larger invertebrates, small fish and even the giant baleen whales (sperm whales) which depend upon straining the plankton from the sea as their primary source of food.



Oceanic
Food Pyramid

Another planktonic form is the Portuguese man-of-war (Physalia). The top of this marine animal is a gas filled float, or sail armed with extremely toxic stinging cells. Physalia stands between the plankton and the nekton which make up actively swimming animals capable of changing their positions at will.

Nekton includes fishes, whales, porpoises, sharks and rays. In our coastal waters common fishes are mullet, tarpon, Spanish mackerel, blue fish, red snapper and grouper. The mullet is a species that feeds upon marine algae while the others feed upon small fish and crustacea. All of these species are important food fish for man with the exception of the tarpon. The blue fish, for example, follow schools of migrating baitfish -- primarily menhaden and fingerling mullet. The blues group in large schools slashing their way through these fish, tearing them to bits, leaving little more than froth of tidbits and crippled fish for dipping, diving terns, gulls and pelicans that follow overhead.

THE LITTORAL ZONE

The littoral zone offers many environments for widely-different marine forms. The Florida littoral zone is sandy. These sandy shores are the result of the erosion, transport and deposit of the sediment at a location. These can be the reef beaches of wide coastal beaches.

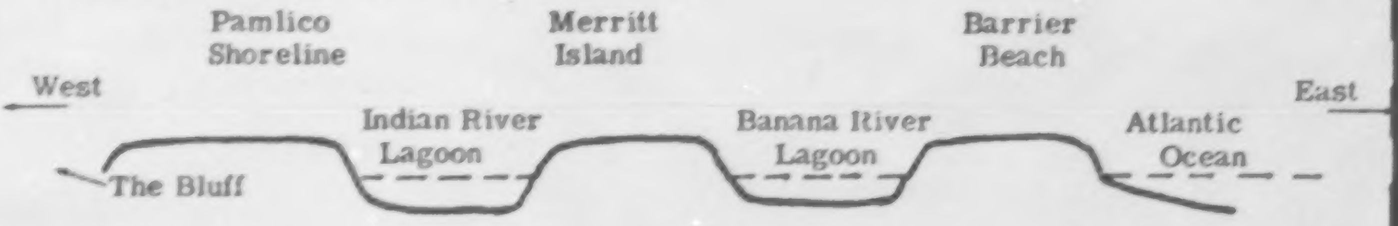
Marine populations in these areas are usually large, but because they are active at night are not usually seen. Small crabs, shrimp, snails and annelid worms live above the surf zone as well as offshore, beyond the surf zone. Oysters, clams, snails and worms provide food for higher order consumers such as shrimp fish, whelks, and starfish. Scavengers, such as the sea urchin and sand dollar, feed on the remains of many kinds of sea life.

Small marine life seeks shelter among sea grasses. In the deeper, cooler regions, where there is little sunlight, a brown seaweed offers a safe place for many sea animals.

The reef beach, a second form of built-up sand is found only on Florida's lower east coast. From Canova Beach to Biscayne Bay, heavy seas keep the water stirred up and cold, making it an ideal environment for the reef-building worm , Sabellariidae. This colonizing worm attaches itself to rocks or firm soil along a shoreline, forming reefs up to two feet thick. In the geologic past, this reef-building activity may have played an important part in beginning a chain of islands along Florida's coast. The reefs formed by the sabellariid worms provide a well-protected environment for the spiny lobster, crab, sea urchin and many fish.

BEACH DUNES

Our ocean beach did not always reside in its present location. In the very recent geological past the ocean shoreline was further inland and in most areas in Brevard County it was located along the west bluff of the Indian River. As the sea level dropped, sand bars were formed to capture two lagoons, the Indian and Banana Rivers, and to form the present barrier beach.



The differences between the plant community along the west bluff of the Indian River and along the present Atlantic beach probably represent the kinds of change (succession) that occur on beach dunes.

The dunes along our present Atlantic beach have the following plant zones: the sea oats zone, the palmetto zone, and the scrub zone. The front of the foredune* is dominated by pioneer species like sea oats, railroad vine and the silver-leaf croton. In the palmetto zone, usually beginning behind the foredune, we find saw-palmetto, sea grape, wax-myrtle and red-cardinal. Further back from the sea is the scrub zone which can develop into climax hammock. Here we find various scrub oaks, gopher apple, stagger bush and love vine, a parasite. Animals of the beach dunes include the lizard, the six-lined race runner, native species of mice and rats, the scrub jay, and ghost crabs. Even the female loggerhead sea turtle invades this community each June, laying her clutch of eggs above the high water mark usually on the face of the foredune.

Scientific Names:

Saw-palmetto	Serenoa repens
Sea oats	Uniola paniculats
Sea grape	Caccilobis uvifera
Railroad-vine	Ipomoea Pes Caprae
Wax myrtle	Myrica cerifera
Red cardinal	Erythrina arbarea
Gopher apple	Geobalanus oblongifolius
Stagger bush	Xalisma fruticasa
Love vine	Cassyth filiformis

Reference:

Kirtz, Herman, Florida Dunes and Scrub Vegetation (Bulletin #23, State of Florida Department of Conservation, Tallahassee, 1942.)

INLETS

Inlets are channels (often man-made) connecting the river with the ocean and offer an avenue of exchange. High tides sweep fresh ocean waters into the river and enables an exchange of nutrients and wastes. Such tidal waters may also bring various life forms which require the estuarine waters to complete their reproductive cycle. At low tide various larval forms may be returned to the ocean to complete their maturation or serve as food for higher order consumers.

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*foredune — the first in a series of dunes; the dune closest to the sea.

The inlet's importance as an avenue of interaction between the sea and the river estuary is sometimes overlooked because the inlet is usually looked upon as a convenience for man's commercial and recreational activities. Inlets must be deep and wide enough to allow freighters as well as both inboard and outboard motor boats' passage into a given port. This waterway must be dredged at times to ensure its continued usefulness to man. The inlet may become more shallow due to the settling of sediments which may be introduced into the water by erosive action of rain, waves, and wakes of boats. Another contributor is the remains of various water plants and animals. The percentage from this source will be influenced by the "health" of the estuarine waters. If large amounts of sewage are introduced, the accumulation will increase.

To slow the accumulation of sediment, large rocks similar to those lining the edge of the inlet, may be layered along the bottom of the inlet. Not only do these rocks deter sedimentation, but also offer a suitable sub-layer for such marine life as sea urchins and sponges.

Though rock-lined inlets may be viewed purely as routes to the sea, the ecosystems sheltered here are much more complex than a quick glance might suggest. The rocks along the side of the inlet, as well as various marker buoys and channel markers, offer a firm underwater layer for various marine organisms to attach. Plants found here are chiefly green algae, brown algae, and seaweeds adapted to the hostile environment created by a ceaseless rise and fall of tide waters. This firm substrate also offers an ideal environment for a number of marine animals, most of which are permanently based filter feeders. These attached marine forms face possible drying-out if low tides expose them to the sun and wind.

An example of an attached filter feeder which has adapted to the hostile environment created by changing tides is the barnacle. This familiar marine form is often found resting on wharf pilings and hulls of boats. It is shielded by a hard, calcium shell which seals in moisture when the tide lowers. When the tide again rises, this shrimp-like creature opens its shell-armor and extends its legs into the surrounding water to capture its prey.

Another well protected neighbor of the barnacle is the limpet. It, too, has an external cone-like shell for protection in a hostile environment. Unlike the barnacle, the limpet's flattened cone shell has no opening; in fact, it fits so firmly to the bottom that a lid is unnecessary. Moisture is kept in a groove circling the inside of the shell, thus, the gills are kept moist until the tide returns. Another feature of the limpet is its diet which consists of marine algae growing on the wave battered rocks. This primitive mollusk is equipped with a long radula, or tongue, which enables it to scrape off algae as it moves slowly over the surface of the rocks.

A third form of marine animal that may inhabit this environment looks more like a plant than an animal; this is the sea anemone. Its flower-like appearance is produced by a cluster of tentacles at the end of a long, slender, tube-like body. These tentacles are simple, hollow, and taper to a point or a ball-like enlargement. The tentacles release microscopic "darts" which secrete a substance which has a paralyzing effect upon microscopic prey. The stunned prey are swept into the mouth, a hollow slit-like pore in the center of a clear, smooth zone, separating it from the tentacles. The base, located at the other end of the cylindrical tube, allows the sea anemone to stay firmly anchored to the hard surface. This base also enables the sea anemone to move. The sea anemone has no protective shell or skeleton for support. The larvae are free-swimming, as are the larval forms of the marine animals mentioned above. It may reproduce sexually or asexually by means of fission or budding. Usually these creatures are found on rocks protected from direct wave action.

After a closer look, it is obvious that the inlet offers a variety of marine life forms to investigate. For the curious ecologist, it is an easy way of observing marine life, undisturbed in marine environment.

Scientific Names:

barnacle — (Balanus balancides)

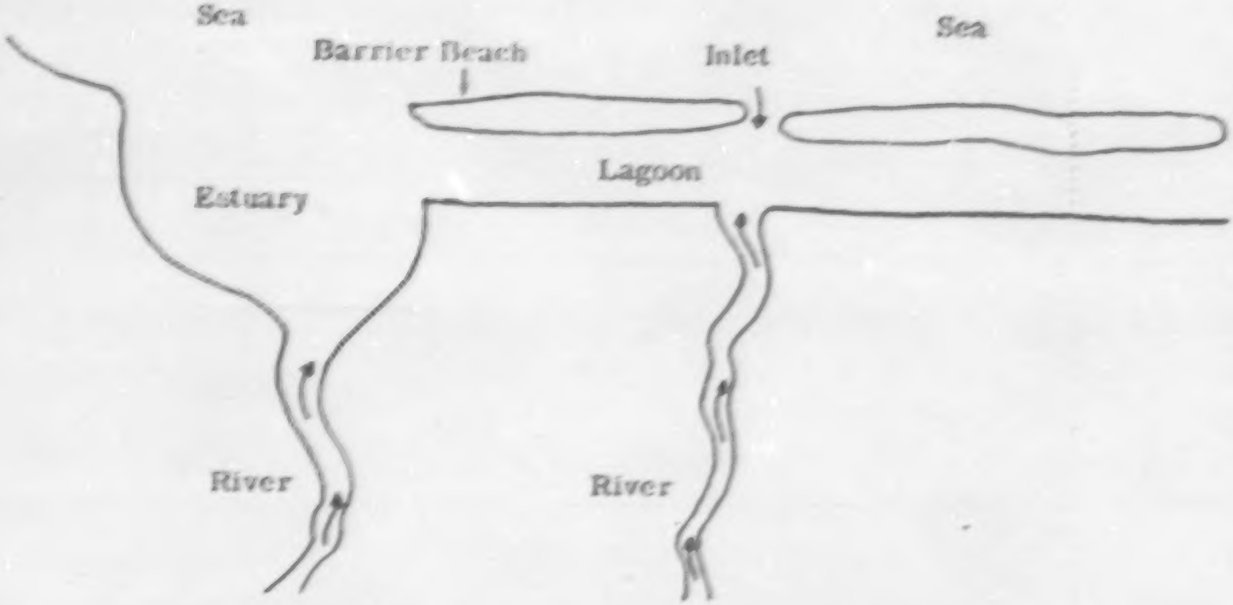
ESTUARIES AND LAGOONS

Estuaries and lagoons have shallow brackish water resulting from the mixing of fresh water and salt water in regions where rivers meet the sea. An estuary is defined as the wide mouth of a river where the tide meets the river's current, while a lagoon is salty water parallel to, and separated from, the sea by a barrier beach. During high tides, water enters the estuary or lagoon from the sea, often rushing under the fresher water which floats on top of the incoming sea water. The outgoing tide reverses this process carrying brackish water back out to sea.

The waters of estuaries and lagoons have many kinds of marine life. One reason for this is the mixing of nutrients carried from the land by rivers and streams with sea water, resulting in the growth-promoting environment known as brackish water. These waters are the sheltered nurseries for many marine fish of great value in sport and commercial fisheries. The basis of this productivity is marine algae, both free-floating and attached. Oysters and clams grow rapidly on the microscopic plant plankton. Algae-eating fish, such as mullet, subsist upon sea lettuce and other attached plants. Even the sea cow, a marine mammal, is completely dependent upon marine vegetation as a source of food.

The predators (animals that feed upon other animals) of the estuaries and lagoons include sea trout, pelicans, ospreys, sting rays and sharks. These animals live on small fish and a variety of shell fish, including shrimp. The estuaries provide quiet shallow waters for the breeding and young of shrimp, sea trout, mullet, snook, and even sea horses.

The waters also produce food for millions of migrating waterbirds. These include scaup, grebe, mergansers, coots and cormorants. Most of these appear in the lagoons and estuaries during the fall, winter, and spring--summers are spent breeding in the wet prairies and tundra of Canada.



In Brevard County our lagoons are the Banana and Indian Rivers.

MANGROVE SWAMP

Mangrove swamps are found in coastal regions throughout the tropics and semi-tropics. In Florida, mangroves were once common along the estuaries and bays from Key West to the delta of the Suwannee River on the west coast and as far north as Brevard County and Merritt Island on the east coast.

The dominant tree is the red mangrove. As the mangrove develops, it sends down roots from its branches until hundreds of roots support the tree above water. It has a red-brown bark. The seeds are also unusual, since they are 10-12 inches long, pencil-shaped, and sprout while still attached to the parent tree. While the fruit is attached to the tree, it sends down a root sometimes several feet long. When the fruit falls, the heavy root holds it upright in the water. When the root tip strikes mud, it begins to grow and form a new tree. The fallen, decaying leaves of mangrove trees collect algae which provide food for young fish. Red mangroves in Brevard County are rare bushes; however, in the great mangrove swamps of the Everglades National Park some of the trees are 70 feet tall and up to 4 feet in diameter. In tidal regions these trees stabilize and build land by holding leaves and silt. When the mud builds up over the roots, the trees die, because the roots need to be washed by water.

On somewhat higher ground the black mangrove is found. This species sends numerous pneumatophores: erect finger-like roots above the soil surface. Other species common on wet salty soils are white mangrove, buttonwood, cocoa-plum, saltwork, sea grape and saltbrush.

Animals of this community are the salt water banded water snake, Clark's water snake, the coconut crab, and the diamond-back terrapin, a turtle. In the Everglades National Park, the alligator and crocodile are both members of this ecosystem. Raccoons, rats, rat snakes, grass "snakes", fiddler crabs, horse shoe crabs and numerous species of fish are plentiful. Also found are many kinds of birds: heron, skimmer, cormorant, catbird, pelican to name a few. In Brevard County this association is found along the east shores of the Banana and Indian Rivers, especially along the entrance road to Long Point County Park.

There are also many mangrove islands found along these rivers which are essentially the same ecosystem. These islands were probably the first "land" sighted by the Spanish explorers. They called them "mangle" (which means "danger") because of the shallow waters surrounding them. They often used the salty leaves of the white mangrove tree to season their food.

Scientific Names:

Red mangrove	Rhizophora mangle
Black mangrove	Avicinia nitida
White mangrove	Laguncularia racemosa
Buttonwood	Conocarpus uvifera
Sea grape	Coccolobus uvifera
Cocoa-plum	Chrysobalanus icaco
Saltwork	Balis maritima
Saltbrush	Baccharis sp.

SALT MARSHES

This plant and animal association is typically grassy with few, if any, trees or shrubs. These grassy areas form a coastal margin between the land and sea and are washed alternately by nutrient-rich runoff from the land and trace-element rich tidal waters. The salt marshes are ideally suited for the growth of algae and plant life. This provides a good food supply for many animals. Grasses are often the dominant and only plants. In Brevard County this association can be seen in the Merritt Island Wildlife Refuge and some other limited areas near the sea.

Characteristic of this habitat are many species of aquatic birds, especially the unique clapper rail. Reptiles adapted to this salty environment are Clark's water snake, a turtle called the diamond-backed terrapin and alligators. Mammals found here include the round tailed muskrat and the marsh rabbit. Raccoons may not live in these areas but they hunt for food in them. Most of the Brevard salt marshes have been diked in order to isolate them from their supply of salt water for mosquito control purposes.

SAND PINE SCRUB

This type community is found on some of the highest elevations in this county; it is essentially an old sand dune association. During Pleistocene[1] time interglacial periods found most of Brevard covered by the sea. Melting glaciers left only a few islands, a chain of windswept dunes running in a north-south direction. The soil is always an almost pure white sand and in some places over 40 feet in depth. The sand pine, a short-needled pine with small cones often used for a Christmas tree in Florida, is the dominant tree. The undergrowth consists of woody shrubs and dwarf trees which include twin oak, myrtle oak, rosemary (with small needle-like leaves) and saw-palmetto. Ground lichens[*] (reindeer moss) are often common.

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[1] Pleistocene — a geologic time period sometimes called the Ice Age. During this time the glaciers formed and moved across the land. The exact time is not known but it is considered to cover about one million years. Some experts consider that it includes present time.

A number of species of animals seem to be confined to this habitat. Found only in the "scrub" are four species of grasshoppers, a spider that builds tube-like holes in woody trunk. Pine flatwoods seldom become hammocks because fire almost always kills most of the hammock trees such as oaks, or maples. In state and national parks, carefully protected from fire, succession toward hammock trees is seen.

Characteristic animals are the miniature "oak toad", the diamond-backed rattlesnake, the opossum, quail, squirrel tree frog, box turtle, red-headed woodpecker and race-runner lizard. The burrows of the gopher tortoise are often seen in well drained areas. Snakes may have adopted these as homes, so beware. This community undoubtedly covers the largest expanse of Brevard County's terrestrial ecosystem.

HAMMOCKS

The name hammock comes from the Indian word for "island." Often this plant growth is found as islands in a stand of pines, in marshes, or grassed areas. The hammock is the final step in succession[**] of the plant community. The hammock may also be called a climax.

The soil of a hammock is usually well drained, moist and high in humus.

The plant life of a hammock can be divided into three height levels. The tallest, or canopy level, consists of trees such as live oak, laurel oak, Florida maple, black gum and cabbage palm. The center layer is made up of smaller trees. These are the sand, a bird, scrub jay, and a fence lizard. These animals probably evolved while isolated on those Pleistocene "islands" which now survive as patches of "scrub." The Florida jay shows little fear of humans. These wild birds are easily trained to eat from one's hand.

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[*] lichens — a group of plant organisms growing together. This is called symbiosis. The two growing together form a plant-like structure.

[**] Succession — The first inhabitants of a plant community are the faster growing and less sturdy plants. They are more able to live and grow under limited nutrients and water. As the soil is built up more woody type plants take over such as the hardwood oak trees.

The largest sand pine scrub in Florida is preserved in the Ocala National Forest. It is known as the "Big Scrub" and has deer, black bear and wildcats in addition to those animal species already listed.

PINE FLATWOODS

These are open pine woodlands dominated by a single species of tree, the slash-pine. The forests often cover large, very level areas in pure stands. The shrubs found here are saw-palmetto, fetter bush, and gall-berry. These are all hardy evergreens that are not killed by frost. The soil is sandy and at a depth of 2-4 feet is underlaid by a "hard pan."[1] Because of this, the ground water is not available to the surface soil and in times of prolonged drought the flatwoods are very dry. In wet weather, however, rainwater may remain at the surface for long periods of time. This water is usually contained in shallow grassy ponds which are ringed by saw-palmetto. These ponds usually contain water from June to October and are dry from November to May. The plants in this community are well adapted to resist fire, which helps shape this community. The special adaptations to fire protection are underground stems (as seen in saw palmetto and runner oaks), fire resistant bark, and in palmetto the lack of sub-cortical cambium.

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[1] Hard Pan — soil layer below the surface of the soil that is so hard, plants cannot penetrate it.

Succession in this community is usually toward a hammock-like structure, but progress in this direction is almost invariably arrested by fire which effectively eliminates most of the typically hammock species, such as oaks, or maples. In State and National Parks, carefully protected from fire, succession toward hammock species is evident.

Characteristic animals are the miniature "oak toad", the diamond-backed rattlesnake, the opposum, quail, squirrel tree frog, box turtle, red bellied wood-pecker and race-runner lizard. The burrows of the gropher tortoise are prevalent in well drained areas.

This community undoubtedly covers the largest expanse of Brevard County's terrestrial ecosystem.

HAMMOCKS

Hammocks in Florida are composed of broadleafed hardwood trees such as oaks and maples in addition to cabbage palms. Pines are conspicuous because of their variety. Hammocks often form "islands" of hardwoods in vast stands of pine (flatwoods) or form similar islands "in marshes". The soil is usually well drained, moist and has a rich humus layer. This community is the climax of the various lines of plant succession.

The vertical structure of the hammock has three layers. The characteristic canopy trees in Brevard hammocks are live oak, laurel oak, Florida maple, black gum and cabbage palm. Small trees often found in the intermediate zone include, marbleberry, the smooth barked stopper, basswood, and redbay. Species on the forest floor include wild coffee, jack-in-the-pulpit, many species of ferns and Hahanela orchids. The smaller trees and shrubs are often of West Indian origin and therefore subtropical species. They are protected from frost by the canopy of larger trees of temperate origin.

FRESH WATER MARSHES

Fresh water marshes once covered a major portion of Brevard County running in a north-south direction paralleling and forming the flood plain of our largest true river, the St. Johns River. Presently, much of this once great marshland has been diked and sebsequently drained by pumping the captured water over the earthen dike into the river channel. The drained land is used primarily for cattle grazing. Here the beautiful insect eating cattle egret has replaced the native fish eating species, the American and snowy egret.

The marshes of the St. John's headwaters, like those of the Everglades, often consist almost entirely of saw-grass. Vast areas of bonnets, water-lilies, pickerel weed, or arrowhead are common. Shrubs include buttonbush with round white flowers and the hibiscus-like marsh mallow. Common birds are the Anhiga, Louisiana herons, Florida mallards, and bitterns. Characteristic amphibia are the large eel-like Amphiuma, the Southern bull-frog and the green tree frog. Common reptiles are the king snake, banded, and green water snakes, ribbon snake, Nelson's turtle and the soft-shell turtle. Mammals include marsh rabbits, opposaums, and round tailed muskrats.

Student Objective: The student will be able to show at least 3 ways the activities of man are affecting the members of one local ecosystem.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, Ecosystems (55-1), Great Barrier Reef (55-3) and Brevard's Oyster Industry May Be Dying Out (36-4)
chart paper, pens

Teaching Suggestions: Originate the activity by having the students read the information card, Ecosystems. After the students have read the card, discuss ecosystems with them. Although your school grounds may not be an entire ecosystem, they are part of one, and you can use them as an example for the students. You may also wish to have additional pictures of other ecosystems available for discussion. Start by having the students list all the living and non-living factors in the school and school grounds. Their lists should include all the plants and animals they can name, as well as buildings, cars, sunlight, rain, wind, temperature and soil. These non-living factors are usually measured to give us a quantitative measure; as amount of rainfall, acidity of the soil. The next question to consider is how these living and non-living things affect each other. For example, how does the amount of rainfall affect the type and number of plants in the ecosystem? Work through several examples as a class before proceeding.

A list of the ecosystems in this area is discussed in the teacher's guide. (card #54) Encourage the students to select ecosystems that are easily accessible to them. Don't forget the city as an ecosystem. If a number of groups are participating, assign each group a different ecosystem to investigate. If the students wish to make quantitative measurements in the ecosystem, they may use the suggestions given on the information card, Measuring the Mini-Climate of a Habitat and in the activity cards on soil.

The students may wish to dramatize their stories for the rest of the class or they may simply record them.

The county commissioners or county health department should be able to answer your questions about regulations protecting the ecosystem. Some ecosystems are protected by national and regional standards as well.

The Great Barrier Reef is an example of an ecosystem that has been endangered by the activities of man. Have the students formulate hypotheses to account for the destruction of the reef. This may also be happening to local ecosystems. Have the students keep a newspaper file of clippings about local ecosystems that are being endangered. This may happen where sewage or garbage is dumped, land is being drastically changed or pollutants are discharged freely. Many living organisms require a delicate balance for life. Small differences in abiotic conditions spell death. Card #57 discusses some animals that are endangered.

Student Obejctive: The student will be able to show, by means of a chart, at least three ways man is changing the character of the biome in which the student lives.

Conceptual Theme: Interaction and Interdependence

Materials: information cards, Biomes (56-1) and
The Biosphere (56-6)
newspaper
magazines, glue, scissors

Teaching Suggestions: As an individual activity this investigation takes time to gather sufficient information. This project could last six weeks or longer. Groups of students could work together each bringing in materials to be used. A scrapbook would be a good way to collect and keep the information. Be sure the students include the good changes as well as the bad.

Have the students begin by reading the information card, Biomes. Biome is a classification ecologists use to characterize areas that have a certain type of dominant plant life. The biome usually gets its name from that plant life (as deciduous forest biome). Plant and animal life will vary within the biome, depending upon local conditions. Altitude makes marked changes in plant life, just as latitude does.

After the students have read about the different biomes, have them decide which biome they live in. Southern Florida is the only example of a tropical forest biome in North America. Discuss other biomes.

The designation biosphere includes air, water, and land where living things are found. This is a very thin layer around the earth. Man is constantly making drastic changes in the biosphere. The students can look throughout the year for pictures and articles that show how man is changing the biosphere. Within their own area, they may be able to visit sites of change, collect data, and inform others of what is happening.

The earlier activity card on the atmosphere (see index) gives some background information of changes in the level of carbon dioxide in the atmosphere. This is due to our increased use of fossil fuels. There is some evidence that some aerosol propellants may be damaging the ozone layer. This layer shields us from harmful radiation.

Student Objective: The student will be able to show how certain changes in the environments of an endangered species has brought about a reduction in their number.

Conceptual Theme: Change and Adaptation

Materials: Audubon, National Wildlife Magazine or other nature magazines
"Florida's Endangered Dozen" (see references)
information cards, Brown Pelican (49-5), The Survivors (57-1)

Teaching Suggestions: Individual or small group activity. The students may have already read about animals that are endangered. Have the student research several animals that are endangered and the reasons for this threat to survival. In almost every case, some drastic change is taking place in the animal's habitat and the animal cannot adapt to this change. Man is frequently the cause of this change, but many natural factors such as drought, floods, can cause such changes. Many animals are simply being crowded out of existence. Other reasons for loss of species include loss of prey or food and poisoning by man's chemicals. Unless man acts to preserve and safeguard large, natural areas for these species, they may disappear.

Information about Florida species can come from several sources. The article "Florida's Endangered Dozen" (see index) is helpful. Brown Pelican gives information about that species.

Audubon and National Wildlife are both excellent sources of photographs and articles on endangered species.

As an art activity, you can try decoupaging pictures of endangered species. On the reverse side, decoupage a typewritten thumbnail sketch of the animal. Directions for easy decoupaging are given in the Teacher's Guide under "Decoupage the Easy Way."

The list of endangered species is available from: Office of Conservation Education, Fish and Wildlife Service, Department of the Interior, Washington, D.C. 20240. Allow four weeks for a reply.

DECOUPAGE THE EASY WAY

1. Prepare the wood. You may burn, stain, or paint the wood.

2. Prepare the print. Spray with a sealer to prevent "bleeding" and to give the print added strength. Tear, cut, or burn the edges of the print.

3. Glue the prepared print onto the finished wood with Elmer's glue. Use a rolling pin to help remove the bubbles.

4. A. Varnish after glue has dried. Use a satin finish varnish. It will take quite a few coats. Let dry between coats. You may put the varnish on with a brush or use cheesecloth.

   B. Or if time is short, you can use shellac diluted with a little alcohol. The alcohol will cut down the time needed for drying.

REFERENCES

SUPPLEMENTAL RESOURCES

A list of supplemental recources follows. These resources have been divided into two parts: those that are general and those that apply to specific investigations.

Several cautions should be noted when reading this section. First, these are supplemental resources. They enhance student or teacher learning on a particular topic. The program, however, can succeed without them. Secondly, care should be taken in reading and selecting resources. Some of the resources present a biased point of view; some are difficult to read. All resources should be previewed by the teacher before they are given to students.

General Resources

"Around the School Yard" Activities
U.S. Forest Service
Portland, Oregon

Free - Simple environmental awareness activities.

Bibliography of Films 16mm Sound: Environment
Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, New York 11040

Free - Bibliography of free loan films on the environment.

Environmental Education: A Guide for Procurement of Free State Agency Services and Materials
Department of Education
Tallahassee, Florida

Free - List of Florida agencies producing environmental education materials. 9 pp.

Environmental Involvement: A Teacher's Guide
Dow Chemical Company
Barstow Building
2020 Dow Center
Midland, MI 48640

Free - Projects and ideas to increase student awareness of the environmental quality problem. Includes bibliography of publications and films dealing with solid wastes; water, air, and noise pollution; and conservation. 17 pp.

Johnny Horizon Environmental Program Packet
Consumer Product Information
Washington, D.C. 20407

Free - Posters, badge, bookmark and pamphlet urging children to become Johnny Horizon's partner in working together to clean up and protect our environment (eg. - give water to a "thirsty-looking" tree).

Lesson Plan for Investigating an Urban Environment, A
U.S. Forest Service
Portland, Oregon

Free - An outline of several environmental studies for urban areas.

National Wildlife Federation EQ Index
National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

Free - Reprint Oct.-Nov. National Wildlife. This booklet covers use and misuse of resources. Gives the status of the environment each year.

Outdoor Classrooms on School Sites
Soil Conservation Service
Information Division
Washington, D.C. 20250

Free - Observe, measure, classify, and interpret interaction and relationships among living things and their natural environment. 24 pp.

Something About Ecology
U.S. Dept. of Interior
Fish and Wildlife Service
Office of Information
Washington, D.C. 20240

Free - This essay defines ecology and the delicate balance living things (including man) must maintain with their environment. It traces several "mistakes" done in the name of progress which offset this balance (eg. - a Borneo pest control program to use DDT to control mosquitoes killing also wasps which once controlled the now rampant caterpillars).

71 Things You Can do to Stop Pollution
Keep America Beautiful
99 Park Avenue
New York, New York 10016

Free - This pamphlet outlines many usable activities for the classroom both by groups and individuals.

Resources by Card

STUDENT CARD #S-1

Ecology: Nature and Needs
American Education Publication, 1972
Columbus, Ohio
$0.35 - Student reading and activities on ecological topics.

STUDENT CARD #S-2

A Cracker History of Okeechobee. Will, Lawrence E.
Great Outdoors Association Craftsmen, 1964

- Glimpse of early settlers in Lake Okeechobee area. Difficult reading for students but good colorful Florida history.

Ecology: Habits and Habitats
American Education Publications, 1972
Columbus, Ohio

$0.35 - Student reading (5th grade level) and activities on ecological topics.

STUDENT CARD #S-3

Ecology. McCue, George
Benziger, Inc., 1971
New York, New York

$1.20 - Student reading, short selections. Teacher's guide.

Ecology: Problems and Progress
American Education Publications, 1972
Columbus, Ohio

$0.35 - Student reading (6th grade level) and activities.

Space Adventure. Cocoa Cola Games
On loan from the Center for Environmental Education to teachers in Brevard County. (Contact your local bottler for information in your area)

- Game centers on use of limited resources during space flight.

STUDENT CARD #S-4

Ecology: Habits and Habitats, Reference Card #S-2

STUDENT CARD #S-5 and S-6

"Homes Tell a Story." Curious Naturalist, Nov. 75
Mass. Audubon Society
Lincoln, Mass. ($3.50/yr.)

Compares homes in different climates.

Man's Habitat - the City
National Wildlife Federation, 1971, order #79061
Washington, D.C.

$1.50 - 28 pp. booklet. Gives the city child a chance to understand ecology without ignoring the influence of man. Community surveys and use of data. Grades 4-9.

STUDENT CARD #S-7

Birds
Mine Publications, 1971
Minneapolis, Minnesota

$3.39 - Student reading and activities on birds.

Bulletins on Animals and How They Live: Bird Nests
National Audubon Society
New York, New York

$3.60 - for 13 different bulletins. Drawings of over 20 birds and their nests.

"How to Find Birds' Nest," Ranger Rick's Nature Magazine
May - June 1972. p. 43.

$7.00 - one year.

"Robins Nest in the Strangest Places," Ranger Rick's Nature Magazine
April 1974.

Pictures of birds' nests in unusual locations.

STUDENT CARD #S-8

Ecology: Nature and Needs, Reference Card #S-1

STUDENT CARD S-9

Agriculture and the Environment

CIBA-GEIGY Corporation
Agricultural Division
Ardsley, New York 10502

Free - 20-minute 2 x 2 slide presentation with brochure. Includes 68 slides and script.

Mark Steel Fights Pollution

American Iron and Steel Institute
Public Relations Department
1000 Sixteenth Street, N.W.
Washington, D.C. 20036

Free - Comic book format. Uses science fiction style to discuss practices and processes being emphasized in the steel industry in response to the industries' environmental awareness. **24 pp.**

Story of Environment and Industry

The American Iron and Steel Institute
Education Department
1000 16th Street, N.W.
Washington, D.C. 20036

Free - 20" x 30" chart that folds into a 8" x 10" book format. Simplifies introduction of the types of environmental pollution.

Trees

Mine Publications, Inc., 1972
Minneapolis, Minnesota

$3.39 - Student activities with trees. Includes leaf classification, a key to tree identification, a tree as a habitat. 123 pp. Colorfully illustrated.

Work in Progress

American Iron and Steel Institute
Public Relations Department
1000 16th Street, N.W.
Washington, D.C. 20036

Free - 27-minute color film. How the awareness of the industry to its responsibilities to the environment is leading to the use of improved pollution control equipment.

Order film from: Association-Sterling Films
866 Third Avenue
New York, New York 10022

STUDENT CARD #S-10

Child's Garden, A

Chevron Chemical Company
Public Relations
200 Bush Street
San Francisco, Calif.

Free - Correlated with the film, Growing, Growing. Excellent gardening ideas including a wide selection of primarily elementary experiments. Stress on excitement and adventure of gardening. Imaginative, detailed, and well illustrated. 45 pp. Teacher resource.

STUDENT CARD #S-10 (cont'd)

Growing, Growing
Chevron Chemical Company
Box 3744
San Francisco, Calif.

Free - 11-minute color film. Can be correlated with booklet, A Child's Garden. Focuses on children's interest in planting seeds and watching plants grow.

Preview prints available: Churchhill Films
662 North Robertson Blvd.
Los Angeles, CA 90069

STUDENT CARD #S-11

Growth of a Tree
American Forest Institute (Poster)
Washington, D.C.

Free - Single copies

STUDENT CARD #S-12

Growth of a Tree, Reference Card #S-11.

Trees, Reference Card #S-9.

STUDENT CARD #S-13

Leaf Functions, BFA Media, 11559 Santa Monica Blvd., Los Angeles, CA 90025

$35.00 - Set of five captioned filmstrips for upper elementary.

Earth is My Home
Scholastic Book Services, 1971
New York, New York

-Student reading and activities.

Growth of a Tree, Reference Card #S-11

"Quiz for Leaf Collectors," Ranger Rick's Nature Magazine
March 1968, p. 35-37.

Sharing the Earth
Scholastic Book Services, 1971
New York, New York

-Student reading and activities.

Trees, Reference Card #S-9.

STUDENT CARD #S-14

"The Chaparral." Carey, Mary - Ranger Rick's Nature Magazine
December 1971

Ecology. Farb, Peter
Time-Life Books
New York, New York

$5.59 - Teacher reference and background reading. Good pictures.

STUDENT CARD #S-15 and S-16

Earth is My Home, Reference Card #S-13.

Field Guide to Soils. Foth and Jacobs
Houghton Mifflin Co., 1971
Boston, Mass.

- Excellent teacher resource. 37 pp. Includes explanation of soil formation and soil studies.

Investigating Your Environment
U.S. Forest Service
Portland, Oregon

Free - for single copies upon request. Student activity sheet. Upper elementary and junior high.

Measure of Our Land, The
Soil Conservation Service
Information Division
Washington, D.C. 20250

Free - Non-technical explanation of how soil scientists study land forms. 22 pp.

Outline for Conservation in Elementary Schools, An
Soil Conservation Service
Information Division
Washington, D.C. 20250

Free - Provides general objectives for environmental education, list of things to do, and list of things to talk about for grades 1-8. Includes graded reading list. 14 pp.

Sediment
Soil Conservation Service
Information Division
Washington, D.C. 20250

Free - How man's activities cause erosion. 16 pp.

Soil and Water Conservation, A Classroom and Field Guide for Teaching
Soil Conservation Service
(same as above)

Free - Twenty-two practical activities. 30 pp.

Soil: Conservation of Florida's Resources With Problems and Suggestions
Florida Dept. of Natural Resources
Larson Building
Tallahassee, FL 32304

Free - A good background pamphlet on soil conservation in Florida discussing soil development, the history of Florida soil conservation, and modern conservation techniques.

Soil Profiles
U.S. Forest Service
Rt. #6
Portland, Oregon

Free - Tells what to look for in soil; color, texture, structure, depth, reaction (pH). Also discusses a general soil profile and how to make micromonoliths. Teacher resource.

STUDENT CARD #S-15 and S-16 (cont'd)

Soil Sampling
Brevard County Agricultural Center
1125 W. King Street
Cocoa, Florida 32922

Free - Gives direction for taking soil samples.

STUDENT CARD #S-17

Concepts in Science - Teacher's Edition, Grade 6
Harcourt, Brace and World.

-Directions for preparing nutrient agar plates.

Earth Is My Home, Reference Card #S-15

Field Guide to Soils, Reference Card #S-15

Measure to Our Land, The, Reference Card #S-15

Outline for Conservation in Elementary Schools, An, Reference Card #S-15

Sediment, Reference Card #S-15

Soil and Water Conservation, A Classroom and Field Guide for Teaching, Ref. #S-15

Soil: Conservation of Florida's Resources With Problems and Suggestions
Reference Card #S-15

Soil Profiles, Reference Card #S-15

Soil Sampling, Reference Card #S-15

STUDENT CARD #S-18

Bulletins on Animals and How They Live: Ways of Wildlife in Winter,
Animals that Hibernate, Mysteries of Bird Migration.
Educational Services, National Audubon Society
950 3rd Avenue
New York, New York 10022

$3.60 - for 13 different bulletins. Explores adaptations to seasons.

Camouflage in the Animal World. Set NB7, 9 Bulletins on Ecology
Educational Services
(same as above)

$2.60 - for 9 Bulletins. Student or teacher resource.

Ecology: Habits and Habitats, Reference Card #S-2

Migration of Birds
U.S. Dept. of Interior
Fish and Wildlife Service
Office of Information
Washington, D.C. 20240

Free - Informative illustrated pamphlet with maps of flyways. Discusses most commonly asked questions of bird migration such as: How far do birds migrate? How high do they fly?

"Nature's Bag of Tricks," Ranger Rick's Nature Magazine
November, 1973

-Camouflage as an adaptation to an environment.
Excellent photographs.

STUDENT CARD #S-18 (cont'd)

"On the Move," Curious Naturalist, October 1971.

Migration as an adaptation.

Puzzle, Ranger Rick's Nature Magazine, Jan. 1973.

Dot-to-dot drawing of an animal that migrates.

"Sidewalk Seasons," Ranger Rick's Nature Magazine, March 1974.

Common sidewalk plants and their seasons.

"Slowing Down," Curious Naturalist, November 1974.

Issue on animal, human adaptations to seasonal changes.

"What do Animals See?" Ranger Rick's Nature Magazine,
February 1973.

-Discusses eyes as an adaptation.

STUDENT CARD #S-19

Adaptations to Water Environments. (Study Prints)
BFA Media, 1972
11559 Santa Monica Blvd.
Los Angeles, CA 90025

$18.00 per set, 3 sets. Excellent photographs of aquatic animals in their natural habitat.

Ecology: Habits and Habitats, Reference Card #S-2

"Nature's Bag of Tricks," Reference Card #S-18

STUDENT CARD #S-20

"Florida's Endangered Dozen" - Florida Wildlife
February 1973.
Environmental Education Consultant
Fla. Dept. of Education
Tallahassee, Florida

Free - upon request. Brief sketches of each endangered animal. Student or teacher reading.

Camouflage in the Animal World, Reference Card #S-18

Ecology: Habits and Habitats, Reference Card #S-2

"If You Were a Bird," Ranger Rick's Nature Magazine
October 1974.

Article on structural adaptations of birds.

"Nature's Bag of Tricks," Reference Card #S-18

"What Do Animals See?" Reference Card #S-18

"Woodpeckers," Ranger Rick's Nature Magazine,
August/Sept. 1974.

Article showing adaptations of woodpeckers.

STUDENT CARD #S-21

Camouflage in the Animal World, Reference Card #S-18

STUDENT CARD #S-21 (cont'd)

Ecology: Habits and Habitats, Reference Card #S-2

"Nature's Bag of Tricks, Reference Card #S-18

STUDENT CARD #S-22

Bird Banding - The Hows and Whys
U.S. Dept. of Interior
(same as before)

Free - This pamphlet discusses the purpose and history of bird banding, techniques and directions on what to do if one finds a band, as well as basic bird conservation information.

"Bird Watching." Ranger Rick's Nature Magazine
March, May June, 1973

$7.00 - one year. Three-part series gives excellent information on birds and their habitats

Birds. Golden Press
Western Publishing Company, 1956
New York, New York

$1.25 - Aid for identification of birds.

Birds.
Mine Publications, 1971
Minneapolis, Minnesota

$3.39 - Student information and activities.

Birds: Conservation Note #1
U. S. Dept. of Interior
Fish and Wildlife Service
Office of Information
Washington, D.C. 20240

Free-A general pamphlet covering names, sizes, locale, food, nests, eggs, migration, banding, extinct species, dangers, protection of U.S. birdlife.

Birds: Their Adaptations to Ways of Life. Set NB3, 14 Bulletins on Animals.
Educational Services
National Audubon Society
950 3rd Avenue
New York, New York 10022

$3.60 - for 14 different bulletins. Student or teacher resource.

Ecology: Habits and Habitats, Reference Card #S-2

"How Many Feathers Does a Bird Have?"
Ranger Rick's Nature Magazine, April 1971. p. 39

$7.00 - one year.

"If You Were a Bird," Ranger Rick's Nature Magazine, Oct. 1974

"A Long Way from Home," Ranger Rick's Nature Magazine,
August/September 1973.

Story about the cattle egret and its success in the U.S.

STUDENT CARD #S-22 (cont'd)

Pictorial Guide to the Birds of North America. Lee Rue, Leonard III
Thomas Crowell Co., 1970
New York, New York

$12.50 - Teacher reference and background information.

Migration of Birds, Reference Card #S-18

"Nature's Bag of Tricks," Reference Card #S-18

"What Makes a Bird a Bird?" Ranger Rick's Nature Magazine
February 1969, p. 17. By Parkes, K.C.

STUDENT CARD #S-23

Ecology: Habits and Habitats, Reference Card #S-2

"The Shaking, Quaking Aspen," Ranger Rick's Nature Magazine
October 1974.

STUDENT CARD #S-24

Ecology, Reference Card #S-3

Ecology: Nature and Needs, Reference Card #S-1

Population Growth
Environmental Science Center
Minneapolis, Minnesota

$.50 - Student activity booklet. Examining and measuring populations.

"Populations," Pringle, Laurence. Ranger Rick's Nature Magazine
April 1973. pp. 22-28

Discussion of different populations.

STUDENT CARD #S-25

Ecology: Problems and Progress, Reference Card #S-3

1971, 72, 73 EQ Index
National Wildlife Federation
1412 16th Street N.W.
Washington, D.C. 20036
Reprinted from October-November National Wildlife

Single reprints free. 2-24 for 25¢. Status of water, air, land quality and population. Updates each year.

Florida Handbook
Available in each school.
Census figures for Florida and counties.

The Population Challenge
Order from Manager of
Public Documents Distribution Center
Pueblo Industrial Park
Pueblo, Colorado 81009
S/N 2400-0444

$2.00 per copy. One of conservation yearbook series. Deals with problems of population. Full color.

STUDENT CARD #S-25 (cont'd)

We

Bureau of the Census, SESA
U.S. Dept. of Commerce
Public Information Office
Room 2089
Federal Office Building #3
Washington, D.C. 20233

Free - 28½-minute color film. Presents selected statistics from the 1970 census.

STUDENT CARD #S-26

How Many Are Too Many?
Pendulum Press, 1972
New Haven, Conn.

$.95 - Student reading &upper elementary) on world population.

The Population Challenge, Reference Card #S-25

"Populations," Reference Card #S-24

This Crowded World, Frankel, Lillian B.
Columbia Books, 1970
Washington, D.C.

$1.50 - Student reading on world population growth.

STUDENT CARD #S-27

Ecology: Problems and Progress, Reference Card #S-3

Equilibrium, January 1974.

1346 Connecticut Ave.,NW
Washington, D.C. 20036

$.75 - Teacher Resource Activities, readings, resources on population.

How Many Are Too Many?, Reference Card #S-26

The Population Challenge, Reference Card #S-25

This Crowded World, Reference Card #S-26

STUDENT CARD #S-28

Ecology: Problems and Progress, Reference Card #S-3

How Many Are Too Many?, Reference Card #S-26

Make Your Own World, Cocoa-Cola Company, 1971.

Game on land planning. Contact your local bottler for availability.

The Population Challenge, Reference Card #S-25

STUDENT CARD #S-29

Focus on Pollution, Part D (Solutions and Controls)
American Edu. Publications, 1972, Columbus, Ohio
$.40 - Student Activity Booklet and Teacher's Guide.

STUDENT CARD #S-29 (cont'd)

Litter - Prevention. . A First Step to Improving the Environment
Keep America Beautiful, Inc.
99 Park Avenue
New York, New York 10016

$.20 each - 1-100 copies. Student activities.

"The Litter Monster"
Alfred Higgins Production
17-minute Film, 16mm, color.

Mapping Small Places
Winston Press, 1972
Minneapolis

$2.94 - Student activities on all types of mapping.

"The Mess We're In," Ranger Rick's Nature Magazine
July 1970

Single reprints free upon request from National Wildlife Federation. Student reading. Explores problem of solid waste.

Our Wounded Land, Pendulum Press, 1972, West Haven, Conn. 06516

$.95 - Teacher or student resource. Explores the problems of solid waste, land use, dwindling resources.

Pollution
Mine Publications, 1972
Minneapolis

$3.39 - Student activities on solid waste, air, water and noise pollution.

"Ranger Rick and His Friends: Adventure 59, What a Waste"
Ranger Rick's Nature Magazine
January 1973

Story stressing need for resource conservation and recovery.

Trash is Taking Over
Environmental Science Center
5400 Glenwood Avenue
Golden Valley, Minn. 55422

$.75 - Student booklet with story, activities on solid waste. 14 pp.

Trouble With Trash, The
Caterpillar Tractor Film Library
160 E. Grand Avenue
Chicago, IL 60611

Free - 28-minute color film. Vivid, forceful portrayal of the positive features of solid waste disposal.

True Book of Maps, The. Carisle, Norman & Madelyn
Children's Press, 1969
Chicago

$3.28 - Simple explanation of maps for students.

STUDENT CARD #S-30

Ecology: Problems and Progress, Reference Card #S-3

STUDENT CARD #S-30 (cont'd)

"Energy from Waste," Curious Naturalist, March 1975.
Mass. Audubon Society

Issue on waste as an energy source.

"The Mess We're In," Reference Card #S-29

McDonald's Ecology Action Pack
McDonald's Ecology Action Pack
Box 2344
Kettering, Ohio 45429

Free – This kit covers energy conservation, water pollution and recycling. Provides authoritative background information . . . with programs and materials for stimulating student projects and activities. Also contains list of additional sources and 12 Spirit Masters for major study areas.

Pollution, Reference Card #S-29

Primer on Solid Waste, A
Mobil Oil Corporation
150 East 42nd Street
New York, New York 10017

Free – leaflet.

"Organic Gardening," Ranger Rick's Nature Magazine
January thru May, 1973.

Excellent five-part series. Goes from composting to natural controls.

Our Wounded Land, Reference Card #29

"Ranger Rick and His Friends," Reference Card #S-29

"Recycling," Ranger Rick's Nature Magazine

Single reprints free upon request from National Wildlife Federation. Student reading. Explains process of recycling.

Recycling: An Ecology Study
Record and filmstrip
Aluminum Association
750 3rd Avenue
New York, New York 10017

Free – upper elementary. Explains recycling and the need for it.

Reynolds Recycling Program for All-Aluminum Cans and Other Aluminum Scrap: A Report
Reynolds Metals Company
6601 West Broad Street
Richmond, VA 23261

Free – A program promoting salvage of waste and scrap aluminum paying 10 cents per pound and being operated in 41 states. 20 pp. Teacher resource.

The Third Pollution (Film)
County Film Library, Brevard County.

Upper elementary. Explores problem of solid waste and some possible solutions.

STUDENT CARD #S-30 (cont'd)

Toward a New Environmental Ethic
Environmental Protection Agency
Washington, D.C.

Free to schools. Explores standards for air, water, solid waste, radiation, noise, pesticides. Covers EPA activities in these areas. Teacher resource.

Trouble With Trash, The, Reference Card #S-29

"What's Happening at Your Hoise?" Ranger Rick's Nature Magazine, January 1973.

Student survey of home for areas of improvement.

STUDENT CARD #S-31

Conservation and the Water Cycle
Soil and Conservation Service
Information Division
Washington, D.C. 20250

Free folder. Color diagram and brief description of the water cycle and its relationship to soil, plants, animals, and man's management of water resources.

Ecology: Problems and Progress, Reference Card #S-3

Our Troubled Waters
Pendulum Press
West Haven, Conn. 1971

$ .95 – Explores water problems we face. Good student and teacher resource.

Outline for Conservation in Elementary Schools, An, Reference Card #S-15

Sharing the Earth. Soucie, Anita Holmes
Scholastic Book Service, 1972.

Student reading and activities.

Soil and Water Conservation, A Classroom and Field Guide for Teaching, Reference Card #S-15.

STUDENT CARD #S-32

Ecology: Habits and Habitats, Reference Card #S-2

Our Troubled Waters, Reference Card #S-31

STUDENT CARD #S-33

1971, 72, 73 EQ Index, Reference Card #S-25

Focus on Pollution, Reference Card #S-29

Pollution, Reference Card #S-29

"What's Happening at Your House?", Reference Card #S-30

STUDENT CARD #S-33 (cont'd)

"Year of Disaster" (Film)
Caterpillar Tractor Company
Advertising Division
Peoria, IL 61611

Free upon request. Community water management. 16mm, 25 min., sound, color.

STUDENT CARD #S-35

Conserving Our Waters and Clearing the Air
American Petroleum Institute
1801 K. Street, N.W.
Washington, D.C.

Free upon request. Student activities. Teacher's guide. Some activities suitable for elementary.

The Do It Yourself Environmental Handbook, Koestner and others.
Little, Brown and Company, 1971.

$1.95 — Teacher and student reference. Suggestions for conservation of energy, water and air.

Ecology: Problems and Progress, Reference Card #S-3

1971, 72,73 EQ Index, Reference Card #S-25

Needed: Clean Water, Problems of Pollution
Water Quality Office
EPA
Washington, D.C. 20460

Free — Cartoon-illustrated booklet on causes, cures, effects of water pollution and avenues of action to alleviate the problem.

"Water—What Would We Do Without It?"
(Reprint from Ranger Rick's Nature Magazine)

Single reprints free. Excellent student resource.

STUDENT CARD #S-36

Conserving Our Waters and Clearning the Air, Reference Card #S-35

Ecology: Problems and Progress, Reference Card #S-3

Needed: Clean Water, Problems of Pollution, Reference Card #S-35

Our Troubled Waters, Reference Card #S-31

A Primer on Water Pollution
Mobil Oil Corporation
150 E. 43rd Street
New York, New York 10017

Free — Newspaper-style pamphlet discussing water pollution with heavy emphasis on oil spills.

It's Time We Face America's Water Problem
Caterpillar Tractor Company
Advertising Division
Peoria, IL 61611

Free — With facts, historic data and pictures, this booklet identifies the problems of water mis-management and ways to solve them.

STUDENT CARD #S-36 (cont'd)

"Water—What Would We Do Without It?", Reference Card #S-35

STUDENT CARD #S-37

Focus on Pollution, Reference Card #S-29

Needed: Clean Water, Problems of Pollution, Reference Card #S-35

Our Troubled Waters, Reference Card #S-31

Pollution, Reference Card #S-29

A Primer on Waste Water Treatment
Environmental Protection Agency, 1971
Washington, D.C.

Free in packet from EPA. Teacher reference. A 24-page booklet discussing types of water pollutants and treatment processes. The need for a look at future water treatment is covered. Simple diagrams, but reading gets technical.

"Ranger Rick and His Friends: Adventure #79, To the Rescue," Ranger Ricks Nature Magazine, February 1975.

Problems with sewage effluent.

Water Pollution—Causes and Cures
Manufacturing Chemists Association
1825 Connecticut Avenue, N.W.
Washington, D.C. 20009

Free — Teacher and student resource. Well illustrated booklet on wastewater treatment.

"Water—What Would We Do Without It?", Reference Card #S-35

Your World, My World
U.S. Environmental Protection Agency, 1973, p. 7.
Washington, D.C.

$1.50 — Student reading. Explanation of EPA and its regular activities.

STUDENT CARD #S-38

Clean Water, It's Up to You
Federal Water Quality Commission
U.S. Dept. of the Interior
Washington, D.C. 20242

A booklet covering existing laws on pollution and ways and means individuals or groups can work to raise water quality standards.

Free copies may be obtained from: Izaac Walton League of America
1326 Waukegan Road
Glenview, IL 60025

It's Time We Face America's Water Problem, Reference Card #S-36

Needed: Clean Water, Problems of Pollution, Reference Card #S-35

Toward a New Environmental Ethic, Reference Card #S-30

STUDENT CARD #S-38 (cont'd)

Water Quality Standards, Better Water for America
Environmental Protection Agency
Water Quality Office
Washington, D.C.

Free upon request. Teacher reference.

Your World, My World, Reference Card #S-37

STUDENT CARD #S-39

Earth is My Home, Reference Card #S-13

Ecology, Reference Card #S-3

Ecology: Problems and Progress, Reference Card #S-3

STUDENT CARD #S-40

Air, Something in the
Caterpillar Tractor Film Library
160 E. Grand Avenue
Chicago, IL 60611

Free — 28-minute color film. Identifies kinds and quantities of air pollutants associated with internal combustion engines.

Air Pollution. Ranger Rick Reprint
National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

Single copy free. Excellent student reference.
Mark and Jimmy find out which of man's activities cause pollution, how to measure the amount of particulates in the air, and compile a list things people can do to help the situation.

Air Pollution Explained: What You Can Do
National Tuberculosis and Respiratory Disease Association, 1970.

Free from your local TB & RD Association. Pamphlet.
- Suggested ways individuals can personally reduce air pollution.

Conserving Our Waters and Cleaning the Air
American Petroleum Institute
1801 K. Street, N.W.
Washington, D.C. 20009

Free — Study Unit for Science and Social Studies Classes, 1968. The source materials include information on the source and information on upper elementary and secondary.

Danger in the Air: Sulfur Oxides and Particulates
Superintendent of Documents, U.S. Gov't Printing Office
Washington, D.C.

$ .40 – Teacher reference. Explains effects of sulfur oxides and particulates on animals, plants, the environment.

Dirty Air
Environmental Science Center
5400 Glenwood Avenue
Golden Valley, Minnesota 55422

$ .75 per copy. Student booklet with stories and activities.

STUDENT CARD #S-40 (cont'd)

Don't You Dare Breathe That Air!
National Tuberculosis and
Respiratory Disease Association, 1970.

Free from your local TB & RD Assoc. Student booklet on air pollution.

Ecology, Reference Card #S-3.

Ecology: Problems and Progress, Reference Card #S-3.

Focus on Pollution, Reference Card #S-29.

Needed: Clean Air (booklet)
Environmental Protection Agency
Washington, D.C.

Free upon request. Cartoon booklet on effects of air pollution.

Pollution, Reference Card #S-29.

A Primer on Air Pollution
Mobil Oil Corporation
150 East 42nd Street
New York, N.Y. 10017

Free upon request. Newspaper size, cartoon-illustrated, pamphlet summarizing automobile, industrial, and home (fuel) sources of air pollution. Section on automobile covers gas tank and carburetor, crankcase, and engine sources. Alternative automobile engines and industrial-home fuels are covered.

Professor Clean Asks - What is Air Pollution?
General Motors Corporation, Public Relations Staff
1-101 General Motors Building
Detroit, Michigan 48202

Free upon request. Story of air pollution and cars (elementary level). Basics of air pollutants and what is being done to make cars less of air pollution problems. Illustrated with children's drawings.

Toward a New Environmental Ethic, Reference Card #S-30.

The World's Exhaust
Pendulum Press, Inc.
West Haven, Conn., 1972

$.95 - Student and teacher reading on air pollution: sources, types, solutions.

Your World, My World, Reference Card #S-37.

STUDENT CARD #S-41

Air Pollution, Reference Card #S-40.

Dirty Air, Reference Card #S-40.

Focus on Pollution, Reference Card #S-29.

Mapping Small Places, Reference Card #S-29.

Pollution, Reference Card #S-29.

STUDENT CARD #S-41 (cont'd)

The True Book of Maps, Reference Card #S-29.

The World's Exhaust, Reference Card #S-40.

STUDENT CARD #S-42.

Air Pollution Explained: What You Can Do, Reference Card #S-40.

Air Pollution, Reference Card #S-40.

Air, Something in the, Reference Card #S-40.

The Automobile
Teacher's Environmental Resource Unit
Center for Environmental Education
Brevard County, Florida 1972

$1.55 - Teacher background.

The Do-It-Yourself Environmental Handbook, Reference Card #S-35.

Professor Clean Asks - What is Air Pollution? Reference Card #S-40.

Troublesome Tail Pipes
Environmental Science Center
5400 Glenwood Avenue
Golden Valley, Minnesota 55422

$.75 - Student reading and activities.

"What's Happening at Your House?" Reference Card #S-30.

The World's Exhaust, Reference Card #S-40.

Your World, My World, Reference Card #S-37.

STUDENT CARD #S-43

Air Pollution Explained: What You Can Do, Reference Card #S-40.

Air Pollution, Reference Card #S-40.

Air, Something in the, Reference Card #S-40.

The Automobile, Reference Card #S-42.

"Man on the Move," Curious Naturalist, October 1974
Explores methods of transportation, energy use.

The World's Exhaust, Reference Card #S-40.

STUDENT CARD #S-45

"The Big Push for Energy," Part One, Ranger Rick's Nature Magazine
January 1973.

- How the use of energy affects the environment.

"Cool House," Ranger Rick's Nature Magazine, May/June 1974.
Tips on saving electricity on cooling.

STUDENT CARD #S-45 (cont'd)

The Do-It-Yourself Environmental Handbook, Reference Card #S-35.

Ecology at Home, Killen, Jacqueline
101 Productions, 1971
San Francisco, CA

$1.95 - Suggestions for conservation in the home.

Questions and Answers About the Electric Utility Industry
Edison Electric Institute
Educational Service
90 Park Avenue
New York, N.Y. 10016

Free - Statistics regarding cost, fuel sources, present and anticipated need, and similar topics related to the electric utility industry. In question and answer format with minimum interpretation of the data. Teacher resource.

School Watt Watcher Hints
Florida Power and Light Company

Free from local FPL office. Teacher's guide on energy and energy conservation activities.

Teacher's Environmental Resource Unit: Energy and Power
Environmental Education Center
Brevard County, Florida

$1.10 - Teacher reference.

35 Watt Watching Ways to Save Electricity and Money
Free - Florida Power and Light Company

What's Happening at Your House?" Reference Card #S-30.

STUDENT CARD #S-46

"Balance of Choices," Curious Naturalist, April 1975.
Mass. Audubon Society
Lincoln, Mass.

$3.50/yr. Issue on energy sources.

"The Best Present of All," Ranger Rick's Nature Magazine
April, May/June 1974.

Story on different sources of energy, their affect on the environment.

"The Big Push for Energy," Reference Card #S-45.

Ecology: Problems and Progress, Reference Card #S-3.

Energy Crisis, The (Film)
Florida Power and Light Company
Available from Brevard Co. Film Library (No. SND-68)

Free - Upper elementary and secondary. Explores our present use of energy and the alternatives for the future. Oil, coal, natural gas, solar, geothermal, nuclear energy are discussed.

STUDENT CARD #S-46 (cont'd)

Energy for Living
Public Documents, Distribution Center
5801 Tabor Avenue
Philadelphia, PA 19120
Document #2400-00758

$.50 - Good teacher resource. Special reprint for U.S. Dept. of Interior conservation Yearbook Series. Examines demand for energy, sources.

"Energy from the Sun," Ranger Rick's Nature Magazine
December 1974.

Article on working solar energy units.

Facts About Oil
American Petroleum Institute
1801 K Street, N.W.
Washington, D.C. 20006

Free - Booklet. Factual material about the oil industry prepared for the teacher. Teacher resource.

"Fossils, Fuels, and the Future," Curious Naturalist
December 1974.

Issue on fossil fuels.

McDonald's Ecology Action Pack, Reference Card #S-30.

Natural Gas Energy and the Environment
American Gas Association
Educational Services
1515 Wilson Blvd.
Arlington, VA 22209

Free - Ecological effects of burning fossil fuels and the general problem of diminishing energy resources. Teacher resource.

Questions and Answers About the Electric Utility Industry, Reference Card #S-45.

School Watt Watcher Hints, Reference Card #S-45.

"Solar Energy, Curious Naturalist, January 75.

Issue on solar energy.

Teacher's Environmental Resource Unit: Energy and Power, Ref. Card #S-45.

35 Watt Watching Ways to Save Electricity and Money, Ref. Card #S-46.

STUDENT CARD #S-47

Focus on Pollution, Reference Card #S-[illegible]

Noise Pollution
Environmental Protection Agency, 1972
Washington, D.C. 20460

Free - Teacher resource. Discusses what noise is, how it affects our health, sources of noise, and some answers. 13 pp.

STUDENT CARD #S-47 (cont'd)

Noise and Transportation
Environmental Protection Agency
Washington, D.C. 10460

Free - This leaflet covers the technical meaning of noise pollution ("energy residuals") and various contribution by aircraft, trucks, cars, etc. Teacher resource.

Noise: The Ultimate Insult
United States EPA
(same as above)

Free - A printed speech of Naturalist, Dr. Alfred Etler, given at the Chicago Noise Hearings in July 1971, on the importance and need of the noiseless world, and what effects noise has had on man's life. Teacher resource.

Pollution, Reference Card #S-29.

Sounds and Silence
Environmental Science Center
5400 Glenwood Avenue
Golden Valley, Minn. 55422

$.75 - Student booklet with stories and activities.

Toward a New Environmental Ethic, Reference Card #S-30.

The Unseen Enemy
Pendulum Press, Inc., 1972
West Haven, Conn.

$.95 - Student booklet on noise.

STUDENT CARD #S-48

9 Bulletins on Insects and Spiders
National Audubon Society
New York, N.Y.

$2.60 per set. Bulletins explore life of selected insects, role they play in nature.

"Dragons of the Air," Ranger Rick's Nature Magazine, March 1975.

Life cycle food chain of dragon flies.

Ecology, Reference Card #S-3.

Ecology: Problems and Progress, Reference Card #S-3.

Household Insects and Their Control, Strayer & Short.
Florida Cooperative Extension
Circular 350

Free upon request.

Poisonous Plants Around the Home, Bulletin 175B
Agricultural Extension Service
Institute of Food and Agricultural Sciences
University of Florida, Gainesville, FL

Free - Complete descriptions (with sketches) of 23 poisonous plants found in Florida communities with habitation-distribution and toxicity of each plant.

STUDENT CARD #S-48 (cont'd)

Poisonous Plants. Rose, Sylvester
Brevard County Agricultural Dept.

Free.

"Ranger Rick and His Friends, Adventure 63, Unwelcome Visitors,"
Ranger Rick's Nature Magazine
February 1973.

- Story about the gypsy moth.

"Your Enemy is—Nasty," Ranger Rick's Nature Magazine
May/June 1975.

- Article on house flies.

STUDENT CARD #S-49

Case Against Hard Pesticides, The
National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

Free - Reprint from Michigan Conservation, Jan.-Feb., 1966, by Ralph A. MacMullan. This booklet discusses the evidence against persistent chemicals such as DDT, heptachlor, lindane, aldrin, endrin, dieldrin, and chlordane, and possible legislation against their use.

Ecology, Reference Card #S-3.

Ecology: Problems and Progress, Reference Card #S-3.

Federal Environmental Pesticide Control Act of 1972 Highlights, The
U.S. Env. Protection Agency, Washington, D.C. 20460

Free - Leaflet. (January 1973) Teacher resource.

Guard Your Garden (Poster)
H.D. Hudson Mfg. Company
154 E. Erie Street
Chicago, IL 60611

Free - 2-color poster. How to apply the pesticides which are needed for lawn and garden care so as to get the job done with minimum overall threat to the environment. Size 18" x 24".

Guardin' Your Garden
H.D. Hudson Mfg. Company
(same as above)

Free - Problems involved in protecting lawns and gardens from insects, disease, and weeds. Provides the point of view of a manufacturer of sprayers and dusters for applying pesticides.

How You Spray Does Make A Difference
H.D. Hudson Mfg. Company
(same as above)

Free - 69 color 2 x 2 slides with script. Shows recommended methods for applying pesticides. Teacher reference.

"Organic Gardening." Reference Card #S-30.

Pesticides Agriculture and the Environment -- Some Often Asked Questions
CIBA-GEIGY Corporation
Agricultural Division
Ardsley, N.Y. 10502

Free - Defends proper use of pesticides. 22 pp.

Pesticides - The Mist of Death
Pendulum Press, Inc. 1971
West Haven, Conn.

$.95 - Student booklet on pesticides.

Pesticides Are Perilous
Env. Science Center, 1970
5400 Glenwood Avenue, Golden View, Minn. 55422

$.75 - Student booklet on effects of pesticides.

Pesticides. Reprinted from Ranger Rick's Nature Magazine
National Wildlife, 1412 16th Street, NW, Washington, DC 20036

Single copy free. Reprint from Ranger Rick. Illustrates how DDT works through a food chain. Also included is a work sheet, more things to discover about pesticides. Good student reference.

Pesticides
EPA, 1971

Free upon request. Information on pesticides.

Pesticides
Educational Servicing Section
National Wildlife Federation
1412 16th Street, NW
Washington, DC 20036

Free - A colorful cartoon-illustrated booklet explaining what pesticides are, what they do, and how they can destroy. Student reference.

Toward a New Environmental Ethic, Reference Card #S-30.

STUDENT CARD #S-50

Ecology. Farb, Peter
Time-Life, 1970
New York

$5.95 - Teacher Reference. Good pictures.

Ecology, Reference Card #S-3.

Ecology Primer
Pendulum Press, West Haven, Conn., 1972

$1.25 - Advance student reading on ecological topics.

The Story of Ecology
National Audubon Society
New York

$.50 - Teacher and advanced student reading. Explores habitats, niches, communities.

STUDENT CARD #S-51

Earth Is My Home, Reference Card #S-13.

Ecology, Farb, Peter, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Habits and Habitats, Reference Card #S-2.

Ecology: Nature and Needs, Reference Card #S-1.

Ecology Primer, Reference Card #S-50.

Ecology: Problems and Progress, Reference Card #S-3.

Food Chain Articles, Ranger Rick's Nature Magazine.
    January 1972, pp. 17-21.
    March 1972, pp. 31,42.
    May/June 1972, p. 9.
    May/June 1974, p. 1.
    April 1975.
    May/June 1975.
    Aug./September 1975.

"Food Energy," Curious Naturalist, September 1974.
    Audubon Society
    Lincoln, Mass. 01773

$3.50 one year. Student explanation of food energy activities.

McDonald's Ecology Action Pack, Reference Card #S-30.

The Story of Ecology, Reference Card #S-50.

STUDENT CARD #S-52

Earth Is My Home, Reference Card #S-13.

Ecology, Farb, Peter, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Habits and Habitats, Reference Card #S-2.

Ecology: Nature and Needs, Reference Card #S-1.

Ecology Primer, Reference Card #S-50.

Ecology: Problems and Progress, Reference Card #S-3.

Food Chain Articles, Reference Card #S-51.

"Food Energy," Reference Card #S-51.

STUDENT CARD #S-53

"Birds of Prey," Ranger Rick's Nature Magazine, March 1974.
- Article of the plight of America's birds of prey.

STUDENT CARD #S-53 (cont'd)

"Bull Snake, The," Ranger Rick's Nature Magazine
March 1974.

Story on pictures about a predator.

Bulletins on Animals and How They Live: Our Friends the Hawks
National Audubon Society, New York

$3.60 for 13 different bulletins. Hawks and their role as predators.

"The Eagle and the Lamb," Ranger Rick's Nature Magazine
March 1975.

A predator is falsely accused.

Ecology, Farb, Peter, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Habits and Habitats, Reference Card #S-2.

Ecology Primer, Reference Card #S-50.

"The Living Desert," Ranger Rick's Nature Magazine
February and March 1973.

Two-part article on what makes a desert and the wildlife of a desert.

"Ranger Rick and His Friends, Terror in the Desert"
Ranger Rick's Nature Magazine, July 1974.

Story involving a bobcat. Discusses the bobcat as a predator.

The Story of Ecology, Reference Card #S-50.

"Timber Wolf," Ranger Rick's Nature Magazine
December 1974.

Investigates some of the myths about predators.

"What Do Animals See?" Reference Card #S-18.

With Us on Earth
Manager, Public Documents
Distribution Center
Pueblo Industrial Park
Pueblo, Colorado 81009
S/N 2400-007600

$.35 per copy. Full color reprint on endangered species. Also examines predator control. 14 pp.

"Who Knows What's for Dinner," Ranger Rick's Nature Magazine
February 1973.

Puzzle match-up pictures of predators and prey.

STUDENT CARD #S-54

"Day/Night in a Meadow," Ranger Rick's Nature Magazine
April, May/June 1975.

Story, sketches about life in a meadow.

Ecology, Farb, Peter, Reference Card #S-50.

STUDENT CARD #S-54 (cont'd)

Ecology, Reference Card #S-3.

Ecology: Nature and Needs, Reference Card #S-1.

Ecology Primer, Reference Card #S-50.

"Life in a Brook," Ranger Rick's Nature Magazine
August/September 1975.

Interrelationships in a brook habitat.

"The Living Desert," Reference Card #S-53.

Ranger Rick's Nature Magazine
October 1972.

Entire issue devoted to a city ecosystem.

The Story of Ecology, Reference Card #S-50.

Togetherness in the World of Nature-Symbiosis. Set NB7, 9 Bulletins on Ecology
National Audubon Society
1130 Fifth Avenue
New York, N.Y. 10028

$2.60 for a set of 9 bulletins. Student or teacher reference.

"A Tree Named Joshua," Ranger Rick's Nature Magazine
August/September 1974.

Joshua tree as a habitat for many animals.

"Urban Wildlife," Lahart, David
Bureau of Environmental Education
Knott Building
Tallahassee, FL 32304

Free - reprint. Describes animals that can be found in a city ecosystem. Teacher reference, 4 pp.

STUDENT CARD #S-55

Ecology, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Man Explores Life. Harris & Steinkamp.
American Edu. Publications, 1970
Columbus, Ohio

$.40 Student reading about ecologist and his investigations.

Ecology Primer, Reference Card #S-50.

"It's Me -- The Gray Blob With No Head"
Ranger Rick's Nature Magazine
March 1974.

Article on oysters, their habitat.

"The Landmakers," Ranger Rick's Nature Magazine
December 1973.

Excellent article on mangroves, their role, and life that depends upon them.

STUDENT CARD #S-55 (cont'd)

"Ranger Rick and His Friends: Adventure #78: Coral Reef in Trouble"
Ranger Rick's Nature Magazine, January 1975.
Investigates Pennekamp Park in the Florida Keys.

Ranger Rick's Nature Magazine, Reference Card #S-54.
October 1972.

The Story of Ecology, Reference Card #S-50.

"Urban Wildlife" Reference Card #S-54.

STUDENT CARD #S-56.

Ecology, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Man Explores Life, Reference Card #S-55.

Ecology: Problems and Progress, Reference Card #S-3.

Ecology Primer, Reference Card #S-50.

"The Living Desert" Reference Card #S-53.

STUDENT CARD #S-57

Bald Eagle, The
U.S. Dept. of Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
Washington, D.C. 20240

Free - 1969 Conservation Note #20. A pamphlet describing the life and behavior of our national symbol and the story of the species demise.

"Birds of Prey," Reference Card #S-53.

"Dead as a Dodo," Ranger Rick's Nature Magazine
by Griffen, E. and Daniel, E.
October 1969

Ecology, Farb, Peter, Reference Card #S-50.

Ecology, Reference Card #S-3.

Ecology: Habits and Habitats, Reference Card #S-2.

Ecology: Nature and Needs, Reference Card #S-1.

Ecology Primer, Reference Card #S-50.

Ecology: Problems and Progress, Reference Card #S-3.

Endangered Species
U.S. Dept. of Interior
(same as above)

Free - Pamphlet series on endangered species.

Florida's Endangered Dozen, Reference Card #S-20.

STUDENT CARD #S-57 (cont'd)

"The Passenger Pigeon," Ranger Rick's Nature Magazine
by Griffen, E. and Daniel, E.
November 1969.

Protecting Our Endangered Birds
U.S. Dept. of Interior
(same as before)

Conservation Note #3. By using photographs of some rare birds, this pamphlet discusses the cause of rarity and the behavior of some common endangered birds.

The Right to Exist
U.S. Government Printing Office
Washington, D.C. 20402

$.25 - Plight of endangered animals.

"The Way to Extinction: The Giant Sable Antelope"
Audubon, May 1971.

One page narrative and one-page drawing.

"The Way to Extinction: The Mountain Gorilla"
Audubon, September 1971.

One page narrative and one-page drawing.

"The Way to Extinction: Spanish Imperial Eagle"
Audubon, January 1972.

One page narrative and one-page drawing.

"The Way to Extinction: The Siberian Tiger"
Audubon, January 1971.

One page narrative and one-page drawing.

With Us On Earth, Reference Card #S-53.

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